THE

ELECTRICAL REVIEW.

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CONTENTS:

	PAGE
Electrical Locomotives	31
Compressed Air for Street Car Motors	33
Relations of Electrical and Mechanical Engineering	33
A New Lorenz Apparatus for the Determination of Resistance in Absolute Measure (*illustrated*)	34
A Telegraphic Feat	36
Diminution of the Luminous Intensity of Arc Lamps with Opal Globes	37
An Investigation with Röntgen Rays on Germinating Plants	37
Technical Literature at the Law Courts	38
Traction Diagrams (*illustrated*)	38
Buda-Pesth Conference, 1896	40
Penson's Concentric Ventilator for Transformer Boxes (*illus.*)	41
Reviews	42
Caveat Vendor	42
Correspondence:—	
"The Pull of a Horse"	43
Efficiency of Transformers	44
Charging for Electric Current	44
The Langdon-Davies Motor	45
Electricity Meters	45
Legal	45
Business Notices, &c.	46
Electric Lighting Notes	47
Electric Traction and Motive Power Notes	49
Telegraph and Telephone Notes	49
Contracts Open and Closed	50
Notes	50
City Notes	53
Traffic Receipts	54
Share List of Electrical Companies	55
Some Notes on Rope Driving (*illustrated*)	56
Single-Phase Alternate Current Transformer in Practice (*illus.*) (*concluded*)	59
New Patents	61
Patents of 1882, Expiring in July, 1896	62
Abstracts of Published Specifications	62

THE

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ELECTRICAL LOCOMOTIVES.

SYSTÈME HEILMANN.

THE *Revue International de l'Electricité* thus resuscitates our old friend the Heilmann locomotive, which, tried in 1893 on the Western Railway of France, has now been reconstructed, or is now reconstructing, of a size to develop 1,350 H.P. (Cheval). Improvements suggested are better suspension of the motors, a new type of steam engine, and modified driver's apparatus. The boiler is to be of ordinary locomotive type. The heating surface will be 180 m², and the grate surface 3·3 m², or about 33 feet—a pretty large order for a European locomotive. The engine is to be a Willans & Robinson, with six cranks, this being the number upon which Captain Sankey has decided as giving a balance of horizontal forces and a very small fraction of the ordinary vertical forces, the connecting rod having a ratio of five cranks. The idea with a locomotive is to get balanced running and equable turning effort, and the Heilmann is designed for high speeds. At a high speed the evenness of turning effort is a chimera, and it is pitiable to see engineers so blind to facts. It is known that a fly-wheel, the total weight of which is 60 tons, and the rim of which runs at 60 miles an hour at 60 turns per minute, has inertia sufficient to keep steady an effort of 1,000 or 1,200 horse-power developed by one cylinder only, or by 120 impulses per minute.

Yet a locomotive and tender, of 60 to 100 tons, not to mention a 200-ton train, is not held to have any steadying power, simply because the mass movement is rectilinear, even though the impulses generating less than 1,000 H.P. occur with eight times the above frequency. Because of inability to grasp this fact, engineers fail to see that a three-cylinder locomotive, with a middle crank and two outside cranks at 180° from the central one, is in as nearly perfect balance as possible, and that there is no need, with high speed locomotives, for the old fashioned idea of cranks at 90°, nor for any kind of even rotative effort. No high speed locomotive ever thinks of slipping at high speeds. It has not got steam to do it, and the Heilmann scheme simply brings electrical working into contempt, for it cannot prove an economy. It carries an immense boiler and a six-crank steam engine, and its one advantage is that in going uphill the steam engine can be run at speed, and will not therefore lose power, as is now the case with a locomotive, which, as it travels slower, also revolves slower, and loses power thereby. But this is to some extent a fable. When a locomotive mounts a hill, it revolves more slowly, and, therefore, gets more pressure, and for an occasional hill it is not usually necessary to take along the whole round house. However, our readers may judge for themselves. The two generators, of a pressure of 450 volts, are excited by a dynamo, driven by its own 28 H.P. engine. The motors are fixed to the frame of the bogies, and have an elastic connection with the

axles. The power is 1,000 H.P. at the rail. The drawbar pull is a little under half the cylinder output. The tyre pull is about 75 per cent. of the cylinder indication, so that, of 1,000 H.P., 250 is lost in the transmission and 250 in the engine considered as a carriage, and the new engines are to be capable of hauling 350 tons at a speed of 100 km. (about 80 miles). It is thought that at present the advantage as to coal consumption rests with the ordinary locomotive. The first Heilmann engine weighed 115 to 120 tons, and only developed 450 H.P., but the new machines are to develop 1,000 at the rail, and apparently only weigh 120 tons or at the rate of 100 kg. per H.P., as compared with the weight of torpedo boat machinery only 16 kg. per H.P., a comparison of little moment, however, considering the difference of conditions. It is expected that these new moving stations will be ready for trial about the end of August. We do not doubt that the locomotive will run; that it will do so at a high speed; that it will haul good loads; that it will be a hill climber. We may admit all this, and more, and we think we shall still be free to paraphrase a famous French saying and repeat, "It is magnificent, but it is not engineering."

Boiler Efficiency.

THE *Electrical World* finds fault with the use of the term efficiency as applied to the results of evaporative tests of boilers. The term is too general and ought to be qualified, where the value of coal is concerned, by a statement as to how the theoretical value of the coal was determined. There are two methods of determining the value of a sample of coal, namely, the chemical and the thermal. By the chemical test the constituents of the coal may be formulated, but its atomic arrangement cannot be known. By the calorimetric test the actual heating power ought to be shown, but is it? There are differences of from 6 to 18 per cent. as between the two systems of testing, and of even 12 per cent. between different calorimeters. Mr. Kent has been studying the subject and has shown possible efficiencies of from 56 to 85 per cent. according to the methods employed, and such enormous differences are sufficient to throw very grave doubts on many so-called close tests of steam plants, and to make men still more careful in accepting conclusions drawn from them. As Mr. Kent says, it is of more importance to know the actual evaporation of water per pound of coal than it is to know the efficiency, especially where so much doubt exists as to the instruments used in measuring. We have already drawn attention to the worthlessness of test records in which conclusions are drawn from determinations of steam dryness —an apparently impossible thing to determine in practice. Finely drawn figures of efficiency must be received with caution.

Foundry Cranes.

THE foundry crane, indeed the general workshop traveller, has various ways in which it receives power. It may carry its own engine and boiler, and for large and heavy work, as in outside operations where a traveller commands a large area, this is a good system. It may be geared with a flying rope, a system which has obtained considerable hold in locomotive sheds, or it may pick up power from a revolving square shaft. Mr. Outerbridge in *Cassier's Magazine* points out how very suitable is electric driving for crane operation. It can be variously applied. A motor may be applied to each motion required, viz., to lifting, traversing and travelling, and it is obvious that when this system is followed, the handling of the crane is most simple, three small switches controlling every motion in either direction. Other cranes, however, are practically like the ordinary crane, and driven by one motor of constant speed the various movements being controlled and regulated by the ordinary mechanisms of clutches, &c. This latter type have the advantage that the motor is always running, and there is steadiness in working and rapidity in starting, by reason of the fly-wheel effects which in the three-motor crane are absent, and, therefore, much current is used at starting. With the three-motor crane, however, we might point out that control is as conveniently arranged from the floor below as from the bridge of the traveller itself, and that the single motor crane cannot be so arranged with any simplicity. A perfect crane must be such that the load cannot run down; it must be pushed down, or in other words, the crane must be self-sustaining in event of accident to the attendant. Looking at the requirements generally, we should incline to the use of three motors by preference. In both travelling and traversing it is the inertia of the carriage only which has to be overcome at a start from a position of rest, for the load is hung below and is free to hang slightly out of the perpendicular just when its sustaining carriage moves. As regards lifting from a state of rest the duty of the motor is usually at starting simply confined to taking up an inch or two of slack, and by the time this is done there is some fly-wheel effect to start the rising load, while, for a falling load, the motor has only to permit the ever ready force of gravity to act and the load moves itself. Mechanical cranes with square shafts or flying ropes consume a good deal of power when doing no work. The electric crane, especially of the three-motor type, ceases its expense with its duty; but, quite apart from questions of economy, electricity should be easily able to put in so good a record as to ensure its adoption wherever that is possible. It is so easy to completely box in, not only the motor but other gearing, that, in this respect alone, for a dusty workshop or foundry, electricity comes an easy first. The great point, however, is the ease with which the power is transmitted to the travelling carriage, the means of doing so being quite imperceptible, except by close examination. Square shafts and tumbling bearings, or flying ropes and grooved pulleys, with the friction clutches needful with them, are all costly things, and should go a long way towards paying for motors, if not much beyond that point.

Efficiency of Transformers.

WITH reference to Mr. Still's letter on this subject, which appears in our "Correspondence" columns, it seems of great importance in these days of vague, and almost impossible specifications, that consulting engineers and others should begin to take things as they are, instead of trying to obtain them as they think they ought to be. The alternate current transformer is not such a perfect piece of apparatus as the young consulting engineer believes that it should be; and since the efficiency of a transformer depends almost entirely upon the weight of material in it, no amount of specifying will make it better than it is *for the same money*. The sooner consulting engineers realise the true meaning of the efficiency of transformers the better it will be, both for the manufacturer who will have rational specifications to quote to, and for the buyer, whose capital will not be wasted.

Hartlepool Tramways.—When describing the Hartlepool Tramways, we omitted to say that the illustrations of the power-house and switchboard had been prepared from excellent photographs by Mr. T. G. Gamlen, of West Hartlepool.

COMPRESSED AIR FOR STREET CAR MOTORS.

The idea of using compressed air for motor work has lately been passing through another period of recrudescence, and it appears that a book has been recently written by Hermann Haupt in favour of air as compared with electricity. Mr. Lundell, in the *Electrical Engineer* (New York), deals with the question on the score of efficiency. We need scarcely point out that the use of air involves two very serious losses. 1st, air when compressed becomes heated and expands, and all this heat is dissipated if the air be not at once used, and becomes a dead loss. When compressed air expands it is cooled, and its mean pressure falls far below the isothermal. There is loss at both ends. Mr. Haupt states that 3,600 cubic feet of free air may be compressed to 2,000 lbs., and used at 125 lbs. to propel a car 12 miles. Mr. Lundell proceeds to criticise these figures, which were obtained under most favourable circumstances as to level and condition of road, and he assumes, neglecting the above-named thermal losses, that the efficiency of a compressor will be 80, and of the motor 75 per cent. The net efficiency of the used air is thus only 60 per cent., even if there were no heat losses, and the air reservoir were large enough to hold all the air at 125 lbs. pressure. But the air reservoir would be too big, and it is therefore requisite to use air compressed to 2,000 lbs. and let out to work at only 125 lbs. The compression diagram above 125 lbs. is, therefore, practically wasted except so far as heating takes place at the reducing valve from free expansion. What can be the efficiency on this system of working?

To compress 3,600 cubic feet per minute to 125 lbs. pressure will call for 495 horse-power, and this represents, therefore, the power to compress air for a one minute service of 8 ton cars. But if the air be compressed to 2,000 lbs. or 136 atmospheres, the consumption of power will be 1,133. These figures are for the impossible isothermal compression. The power for adiabatic compression in the two cases would be 678 and 2,480 horse-power, and the efficiency, instead of $\frac{495}{1133}$, or 44 per cent. would fall to only 27 per cent.; but it is fair to assume in practice a 40 per cent. performance. This with a mechanical efficiency of 70 for so high a pressure, would give with a 75 per cent. efficient motor, a total plant efficiency of $70 \times 40 \times 75$, or 21 per cent. only. Air thus compressed must have some provision for reheating, or working would be impossible, so great would be the cooling. Very high pressure air is thus seen to have a total efficiency of about a fifth, and compares very poorly with electricity. It is scarcely fair, however, to take so poor a case for air. There is a system described to us by Mr. Norman Selfe, of Sydney, N.S.W., but the name of which has been forgotten by us, wherein the motor only carries air at a comparatively moderate pressure, and it can always pick up a fresh supply along the track. Air is compressed at a central station and laid along the track in pipes. At frequent intervals are placed spigots, to call the appliance by some name. From the motor there is a short hose pipe with a special brass end. This is jammed into the air supply "spigot," and the motor is in a sense automatically recharged with very little trouble. We cannot say to what extent the system was adopted, nor if any special practical difficulties cropped up in its working, but Mr. Selfe spoke highly of it, and we cannot doubt it would be far more efficient than the use of such excessively high pressures as 2,000 lbs. But air cannot compete with electricity in efficiency, and we merely mention the system because we think Mr. Lundell has rather over stated the case against air. However, it is said that the Madison Avenue line of the Metropolitan Company of New York is to be equipped with air motors carrying reservoir pressures of 2,000 lbs. The fact that some electric cars are fitted with a pair of 25 H.P. motors is by no means to be made a basis of contentious argument. The truth of the matter is, that with the use of electricity has sprung up a demand for very rapid starting, and it is this has gradually brought up the power from the two 7½-H.P. machines used by Mr. Sprague at Richmond, to the two 25-H.P. of to-day. This is for American practice, where, as our contemporary points out, a car is allowed to be loaded to double, or even we would add treble what is considered a load in Europe. This power of carrying heavy loads for a short time is altogether in favour of electricity, as it enables rapid starts to be made without sacrificing efficiency after speed has been attained. During the past winter several cars have been run on the Madison Avenue line with storage batteries, and the company have been studying the working of the conduit system on Lenox Avenue. Clearly the overhead system is not having it all its own way in New York, and our contemporary looks upon the air system merely as a makeshift pending final settlement, in favour of some one or other form of electrical working. It does not in fact, regard the air system otherwise than as a temporary makeshift. Where any compressed gas must be carried we should far rather suppose that economy would lie with compressed combustible gas to work a gas engine, using compression simply to keep the bulk small, than as a system of power storage. Air finds its special and peculiar field in mining and kindred industries, but it cannot even under most favourable conditions compete with electricity.

RELATIONS OF ELECTRICAL AND MECHANICAL ENGINEERING.

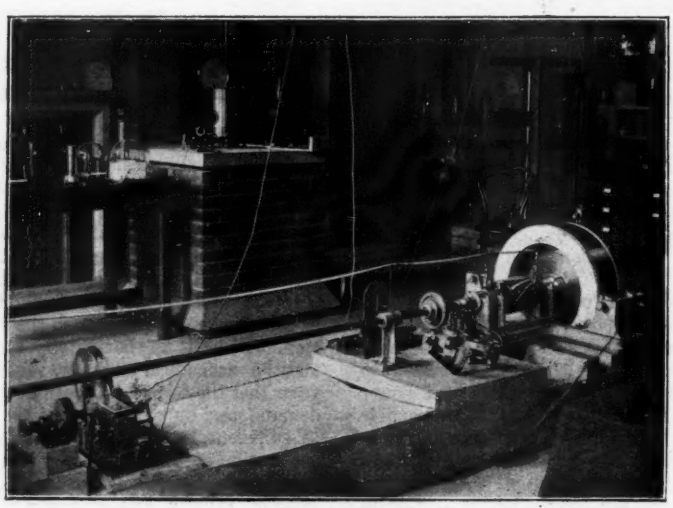
Writing in the *Engineering Magazine*, Mr. Elias E. Ries compares the electrical engineering of to-day with the work of the old time electrician which was confined chiefly to telegraphic and other work demanding a good deal of scientific knowledge, and very little electricity, and that only in the form of weak currents, and employing mechanically rather the brass worker or philosophical instrument maker than the mechanical engineer who to-day carries on the work of electrical engineering with the scientific aid of the electrician. There is no sharp division now between the electrical and the mechanical engineer, yet it is only within quite a few years that the former has been evolved as a product of a new demand, and only in 1884 was the new profession recognised as sufficient to warrant the foundation of the American Institution of Electrical Engineers. The strides of a few years have been enormous. Electric light, power transmission, railway and tramway work and numerous other applications have been developed in an extraordinarily rapid manner, and to-day electrical work is one of the principal props of the mechanical engineering trade, indeed, mechanical engineering has become of far less relative importance, though we should hesitate to say it was an appanage of electrical engineering.

The functions of the electrician, using the term in the older and narrower sense, do not largely encroach upon the domain of the mechanical engineer, and herein lies the difference between the electrician and the electrical engineer; but even in electrical engineering there are very different branches, and the knowledge necessary to the installing engineer differs from that of the constructor of machinery. Dynamos are to-day bought very much as are steam engines, and there are scores of men who have to deal very largely with electrical work who would be puzzled how to wind a dynamo or calculate its proportions for best effect. They do not consider they are any more bound to understand such details than a carpenter considers himself obliged to know how nails are made, and there is much to be said in favour of this view. Life is too short to learn everything of all the details used in any man's line of work. The work of the modern electrical engineer very much resembles that of the mechanical engineer in being of a broad nature, and involving general work rather than an intimate knowledge of details. Of course, if a man has the general capacity and the detail knowledge as well, he is a genius, but we cannot all be so. Indeed, as pointed out by our author, the early attempts at combining electrical knowledge with mechanical were examples of dismal failure, and great discredit attached to electrical work from the extreme poverty of its mechanical construction, which had about as much relation to proper construction as a diagram out of one of Rankine's works has to a working drawing. Mr. Ries deprecates any suggestion to merge into one the professions of electrical and mechanical engineering. There is too great a distinction in the special qualifications of the two to warrant it, and while, of course, there must always be a deal of overlapping of the two, there will, we think, long remain a broad area at each end of what we might term the

engineering spectrum where there is no overlapping, which will be confined to the middle area. We may say this is electrical engineering, and that, is mechanical, if we confine ourselves to the extremes in each profession, but of the middle, we can only say, this pertains more or less to both. The extremes are to be filled by the specialists; the middle zone is the field for the general practitioner.

A NEW LORENZ APPARATUS FOR THE DETERMINATION OF RESISTANCE IN ABSOLUTE MEASURE.

THIS set of apparatus has been designed and carried out by Messrs. Nalder Bros. & Co., of Clerkenwell, for Prof. Callendar of the McGill University, Montreal, under the supervision of Prof. Viriamu Jones, F.R.S., of the University College, Cardiff, who has had so much experience of this method, and has contributed several papers to the Royal and Physical Societies on the subject. Messrs. Nalder's apparatus appears to be a triumph of mechanical design and workmanship, so much so, that the deviation of the coil from true circular form being only $\frac{1}{15}$th of that in the older form of the Jones apparatus.



LORENZ APPARATUS.

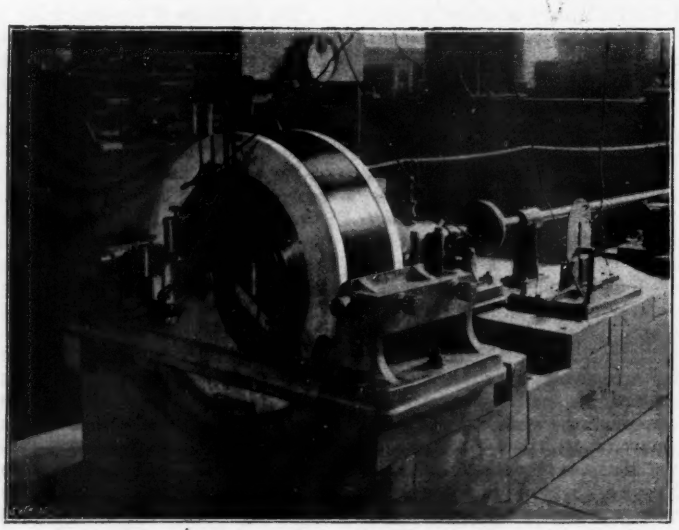
The Lorenz method, as is well known, consists in rotating a disc inside a coil or solenoid, so as to cut the lines of force produced by the current flowing in the coil. The E. M. F. induced between the centre and the periphery of the disc is varied by varying the rate of rotation of the disc until it is equal to the potential difference at the terminals of the resistance to be measured when the same current passes through it and the coil.

If M be the coefficient of mutual induction of the disc and coil, and C the current, then M C is the number of lines passing through the disc when the current, C, flows round the coil. This number of lines is cut once by every radius of the disc at each revolution, and consequently, if the disc make n revolutions per second, the number of lines cut per second, which is the E.M.F. between the centre and edge of the disc, will be M C n. But, since the same current, C, passes through the resistance, R, to be measured, the P.D. at its terminals will be R C. Hence, since these are made equal, M C n = R C, or R = M n.

It is thus seen that the resistance is measured directly in terms of the coefficient of mutual induction, which is a constant of the apparatus, and the speed of the disc, and, in accordance with the electro-magnetic theory, it is expressed as a velocity. The apparatus has thus to be constructed so that the coefficient of mutual induction of the coil and the disc is capable of being calculated, and it must also be provided with a means of measuring the speed of rotation of the disc.

In order to calculate the coefficient of mutual induction with sufficient accuracy, the apparatus must be so constructed that the dimensions of the disc and coil can be very accurately ascertained.

In Prof. Viriamu Jones's own apparatus, he uses a cylindrical coil, consisting of a helix of wire of one layer. This form was adopted because the dimensions could be accurately determined, the compression of inner layers being avoided, and because Prof. Jones found it possible to establish a very exact series for the calculation of the mutual induction of a circle and a coaxial helix.* In Prof. Jones's apparatus the coil consists of a cylinder of brass, on which a screw thread was accurately cut to receive the silk-covered wire. The coil, however, from internal strains, is slightly elliptical, and the silk insulation prevents a very exact determination of the diameter.



LORENZ APPARATUS.

In the apparatus just constructed by Messrs. Nalder Bros. & Co., both these difficulties have been, to a great extent, overcome. Instead of the cylinder of brass, a massive cylinder of fine grained well paraffined marble is used. The dimensions of the marble cylinder or ring are 21 inches external diameter, 15 inches internal diameter, and 7 inches axial length. A screw thread, of 40 threads to the inch, and of nearly semicircular section, is cut on the surface of the cylinder over a length of 5½ inches. The greatest care had to be taken in cutting this screw; it was found that small variations of temperature were sufficient to cause unequal cutting. In the helical groove 200 turns of specially drawn, bare copper wire, 21 mils. diameter, were wound, thus allowing 4 mils. of air insulation between consecutive turns. The wire was thus extended over an axial length of 5 inches, and the ends were passed through ebonite bushes securely fixed in the marble, and let out by twisted flexible conductors.

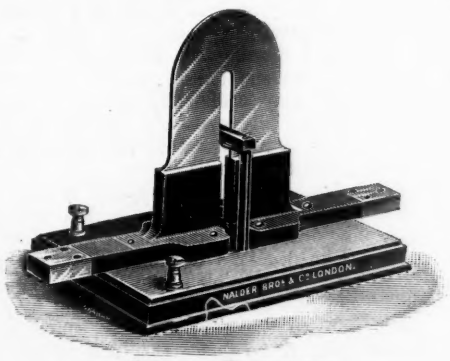
The advantage of using the marble ring was two-fold; its low coefficient of expansion, freedom from internal strain, and rigidity, tended to greater constancy of dimensions, and its insulating properties, when paraffined, allowed the use of bare wire.

While the coil was still in the lathe, two lines were cut, one on each edge of the coil, equidistant from the mean plane of the wire as given by the leading screw of the lathe. These

* *Phil. Trans.*, 1891. *Proc. Phy. Soc.*, November, 1888 (*Phil. Mag.*, January, 1889).

lines are for the purpose of testing whether the mean plane of the coil is coincident with that of the disc.

Each edge of the coil was also divided on the face at intervals of 10°. By means of a Whitworth measuring



Standard Resistance.

machine, 18 diameters of the coil, 10° apart, were measured, both in the mean plane and at the edges of the coil.

The mean diameter at the centre and the edges of the coil did not differ from the largest and the smallest diameters by $\frac{1}{1000}$th of an inch. In the brass coil used by Prof. Jones, the largest and smallest diameters differed by ·0158 inch, which shows the great superiority of the marble to resist deformation.

The observations also showed a standard deviation of ·00035 inch, or less than two parts in 100,000 from the true circular form, while in Prof. Jones's coil the corresponding deviation would be ·006 inch, or nearly three parts in 10,000.

The rotating disc is 13 inches in diameter, and consists of a phosphor bronze casting, which is bolted on to a boss on the end of the phosphor shaft, from which it is carefully insulated by ebonite. The heads of the bolts are recessed in the boss, run in with wax, and covered over with a plate to prevent mercury entering and impairing the insulation. The disc was first carefully turned up, and was finally ground true in its own bearings. Measurements taken at four diameters showed that it was practically uniform.

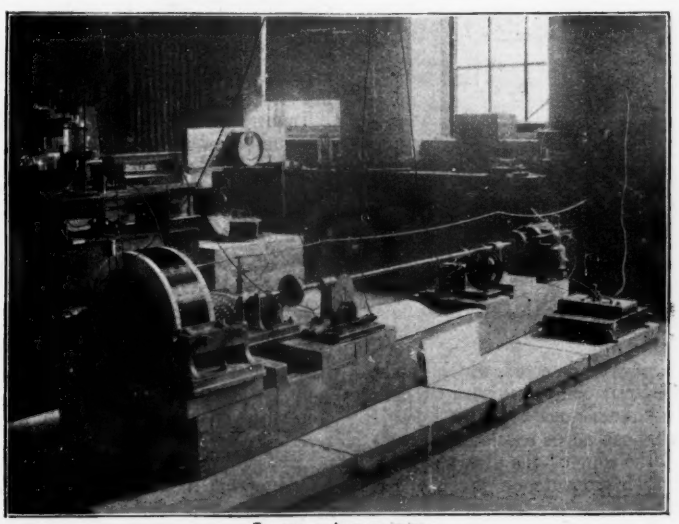
The apparatus for measuring the speed of rotation consists of a stroboscopic device, to show when the speed is uniform, and a counting mechanism which registers the number of revolutions on a chronograph.

The stroboscopic device consists of a large tuning fork, which is kept in vibration by a short electro-magnet placed between the prongs, and excited by a current interrupted by one of the prongs. To the ends of each prong is fixed a piece of sheet zinc, having a narrow slit. When the prongs of the fork come together the two slits coincide, and the light can pass through; when the prongs are separated, the opening is closed. The observer looks through this opening at a cylinder on the axis of the disc. The surface of the cylinder is divided into rings, and these rings are divided into different numbers of alternately black and white sections. When looked at through coincident openings of the pieces of zinc, one of the rings of white spots will appear stationary when the speed is uniform. If the spots are not stationary, the speed is regulated by altering the resistance in the electromotor circuit.

In the chronographic apparatus for measuring the speed, a strip of paper saturated with starch and potassic iodide is drawn forward by clockwork. Three springs press on this paper ribbon as it passes over a metal cylinder. One is from a standard clock, which sends a current every second; another receives a current at every revolution of the disc, and the third at every tenth revolution of the disc. An ingenious device introduced by Mr. Drysdale in the clockwork, enables the scale to be magnified at the beginning and end of the experiment. This consists of a copper disc in the clock-train, which can be retarded when desired, by exciting a small electro-magnet in its neighbourhood.

The apparatus has such a coefficient of mutual induction that, with a convenient working speed of about 650 revolutions per minute, it will balance a resistance of $\frac{1}{2000}$th of an ohm.

This renders the apparatus very suitable for the direct determination of the specific resistance of mercury, since, as in Prof. Jones's investigations, a mercury trough of large dimensions can be employed, permitting great accuracy of measurement. For direct comparison with resistance coils an arrangement of two 10-ohm and two $\frac{1}{10}$-ohm coils can be employed as in Lord Rayleigh's determinations, or a low resistance standard may be used. In the illustration such a standard is seen connected up, being the form devised by Prof. Viriamu Jones for use with this apparatus, and for current measurements by potentiometer. A plate of platinoid, manganin, or other alloy is cut into the form of a V, the limbs of which are sweated into massive copper leading-in blocks. The potentiometer terminals, which arise between the limbs, are in one piece with the plate, and are connected to two terminals on the base. The advantages of the arrangement are: great ease and accuracy of adjustment, large cooling surface, and great permanency of resistance, since no joints are made at the potentiometer contacts.



Lorenz Apparatus.

The marble cylinder is mounted on a phosphor bronze cradle, which can be adjusted in any direction by screws. To effect the adjustment of the cylinder so that the disc shall be concentric and in the mean plain of the coil, an attachment is clamped on the disc, which carries a micrometer screw and a microscope. By screwing the end of the micrometer screw against the coil at a number of points round the circumference, the cradle can be adjusted till the coil is concentric with the disc. The longitudinal adjustment of the cylinder is made with the microscope, and the lines marked on the cylinder at the edge of the coil.

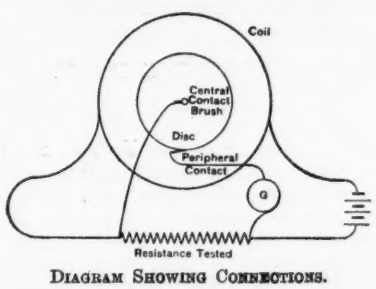
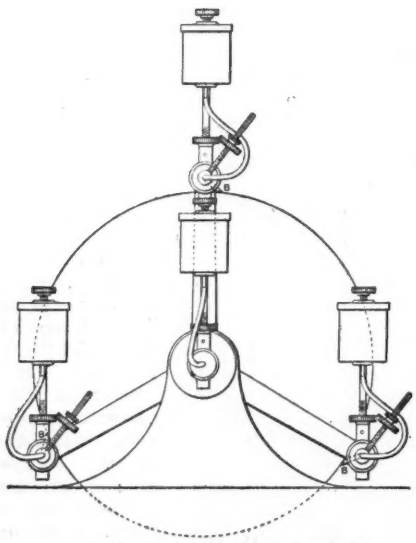


Diagram Showing Connections.

The disc is driven by an electromotor at the further end of a 6-foot shaft, so as to obviate all risk of disturbance of the coefficient of mutual induction of the disc and the coil. Next to the disc comes the stroboscopic cylinder, then the

contact apparatus for every single and tenth revolution, then the chronograph, and finally the electromotor. The bearings, which are scraped true, are lubricated by a constant supply of oil under pressure from a small centrifugal pump. There are two slightly flexible couplings in the shaft to yield, in case the bearings should not be perfectly in line.

The brushes are four in number, three bearing on the periphery and one on the centre. The three peripheral brushes are carried on a star turning about the axis and make contact on the edge of the disc, the fourth fits in a recess in the centre of the disc. All these brushes are tubes, and are connected to vessels containing mercury, and having cocks by which a constant stream of mercury can pass on to the disc at the contacts, thus securing perfect electrical continuity. By inserting a galvanometer between any two of



End View of Disc showing Mercury Brush Device.
B. B. B. Mercury Brushes.

the peripheral brushes a P.D. may be detected, which would show that the disc was not perfectly concentric with the coil. It is proposed to use this circumstance for the adjustment of the coil. The brushes can all be regulated so as to bear exactly on the centre of the edge of the disc, and have adjustable weights by which their pressure on the disc can be adjusted.

By the kindness of Prof. Ayrton, the apparatus will be tested at the Central Technical College, and a determination will be made by Prof. Viriamu Jones and Prof. Ayrton.

Messrs. Nalder Bros. & Co. desire, in this connection, to acknowledge their indebtedness to their assistant Mr. C. V. Drysdale for the valuable assistance he has rendered them in the design and construction of this piece of apparatus.

A TELEGRAPHIC FEAT.

At the Electrical Exposition in New York on the night of Saturday, May 16th, the visitors were treated to an interesting series of telegraphic matches against time. The telegraph seems never to lose its interest as a side-show at evening gatherings, no matter whether the "lines" are genuine ones, or whether, as is sometimes the case, a man seated behind a massive briar in an adjoining room, represents in turn St. Petersburg, Constantinople and Timbuctoo. All those telegraph engineers who have taken part in arranging such entertainments, must have been struck with the fact that when the public is being "humbugged" with dummy lines, everything passes off without a hitch and without a murmur; while when real lines are joined up, and distant stations actually worked with, not only does any selected line invariably fail immediately the big gun of the evening begins to write out his message, but it is almost impossible to convince the majority of the visitors that the whole concern is not an absolute fraud. We are entirely at a loss to understand why the public should adopt this attitude, but the moral evidently is:—Pin your faith to the man behind the briar in an adjoining room, hang some good maps in front of him, and also a card showing the differences of time at the most important Continental cities; and if he be a fairly intelligent man, you may confidently switch through to almost any station, and rely upon the admiration of the public, as well as endless repetitions of the quotation from Shakespeare concerning the "girdle."

The New York business, however, appears to have been genuine. Messages were sent by more or less important people to other more or less important people in another part of the same room, the distances travelled by the messages being made as great as possible; and as an ingenious arrangement of incandescent lamps on a large map was employed to indicate to the multitude the course of the various messages, we have no doubt that many people were enabled to form a fairly good opinion as to the marvellous pitch of perfection at which telegraphy has arrived. The days of infantile experiment in telegraphy are now over, and because telegraph engineers make little fuss, it is frequently forgotten that in the science and art of their profession telegraph men are still far ahead of their lighting and power transmission brethren, besides having more money at stake. Indeed, could we but obtain immunity from the frequent and distressing blunders of operators, we might now well be content to allow telegraphy to follow its slow, natural course of improvement. But of what use is celerity, and of what avail the wonders of the quadruplex and multiplex if we cannot *rely* upon the correct transmission of our telegrams?

Inquire of any business man, and he will inform you that the number of telegrams received by him in the course of a year free from a blunder of some kind is surprisingly small; that is, the percentage of messages with errors is very great. A telegraph official will, on the other hand, inform you that the number of messages in which errors occur is but a small percentage of the total number transmitted; but if you inquire as to the basis of his calculation, you will discover that he assumes that every telegram has been correctly transmitted unless a formal complaint is received concerning its incorrect transmission, ignoring the fact that in the great majority of instances no formal complaint is lodged.

But to return again to the New York performance. The messages were despatched from one part of the room and received at another part, after having been transmitted "as nearly as possible round the earth." The reservation reminds us that the earth has not yet been encircled by telegraph lines, and until we get the long promised Pacific cable it will not be possible to run a trial on this ideal telegraphic racecourse. Perhaps the most interesting route was that taken by the message sent by Mr. Channcey M. Depew to Mr. Edward D. Adams *via* San Francisco, Newfoundland, London, Lisbon, Gibraltar, Alexandria, Bombay and Singapore to Tokio in Japan, whence it was repeated back over almost the same route to New York. The entire message consisted of 27 words, and its journey of 42,872 miles was performed in 50 minutes. We imagine that the message would have to be re-transmitted at least 20 times, and as the average time actually occupied in every re-transmission would be about one minute, it is evident that the performance was a remarkably good one. In ordinary cases by far the greater part of the delay is caused by the message having to wait its turn with others, and the phenomenal rate of transmission in the present instance could, of course, only have been obtained by keeping the lines throughout clear for the message, and probably also arranging as far as possible for the operators to commence transmitting immediately another operator started receiving from the preceding section. The lesson to be learned (and it has frequently been learned before) is that quickness in telegraphing cannot in any way be materially increased by reducing the time actually taken by the signals in traversing even very great distances, but every improvement is to be looked for in the direction of skilful dealing with the traffic, the provision of a sufficient number of channels on busy routes to avoid blocks, and the reduction of delay in the delivery to the addressee after the message has arrived at the end of its telegraphic journey.

The following table of distances will explain more clearly the route taken by Mr. Depew's message:—

	Miles.
New York to San Francisco	4,118
San Francisco to Canso	4,914
Canso to London	2,823
London to Tokio	13,677
Tokio to London	13,677
London to New York	3,663
Grand total	42,872

So far as we can learn, the addressee was able to read this message when it reached him without the aid of a handwriting expert, and he had no occasion to complain of errors therein. This happy result may be due to the fact that the message was started on its journey by being sent on the gold "key" with which the Chicago Exhibition was electrically opened, or it may be that the route selected enabled the message to be doctored up, say at London, on its return journey; but it is probably to be accounted for by the fact that at the stations through which it passed, highly skilled operators only are employed.

It would be exceedingly interesting to peruse a list of the stations at which the message was re-transmitted, together with the names and pedigrees of the operators engaged in the work. Perhaps one of our American contemporaries will, at the risk of slightly increasing our national pride, be kind enough to publish such a list. It will probably be found that every operator employed is a member of the great Anglo-Saxon race, and that nearly every man was born and trained in the United Kingdom. If our inland lines were worked by such men, and such men only, there would be an end to grumbling on the part of the public.

DIMINUTION OF THE LUMINOUS INTENSITY OF ARC LAMPS WITH OPAL GLOBES.

It is really not easy to obtain reliable information as to the loss of light caused by the employment of opal or ground glass globes for powerful electrical lights. It seems to be the custom to fix it at 20, 30, or 40 per cent., according to the fancy of the writers without taking the trouble to base any of these values on careful observation, or if they are based on observation at all, the results of experiments made many years ago, go on being quoted, without any notice being taken of the improvements that have been since made in the globes in question.

In the *Elektrotechnische Zeitung* (No. 32, 1895), M. Th. Stort gives details of experiments during which the maximum absorption observed was 11 per cent.

The lamps used were 10-ampere regulators, fitted with carbons, the positive of which was 17 mm. in diameter, and the negative 10. The figures were as follows:—

	Luminous intensities in candles.			
	Maximum.	Spherical mean lower half.	Total spherical mean.	Loss per cent.
Naked lights ...	1,161	635	362	0
Clear globes ...	1,165·5	605·8	336·1	6
Frosted globes ...	653·5	494	320	11

The fact that losses of 30 to 40 per cent. are by no means uncommon, according to circumstances, renders it all the more important that the actual influence of the globes themselves should be determined. In towns it often happens that the loss of light is largely due to neglected accumulations of dust and soot.

The 10-ampere regulators gave as a maximum 116·5 carcels, or a spherical mean of 63·5 carcels above, and 36·2 below the horizontal plane passing through the light. These lights are therefore far from attaining to the 100 carcels attributed to them, and it does not seem that during the past 15 years any great improvement has been effected as regards their luminous efficiency, although their working has become better, the consumption of carbons more regular, and the light more stable. With regard to incandescence lamps, we may refer to the experiments recently made by Mr. James Fawcus. He found that with many lamps having an initial consumption of about 4 watts per candle the luminous intensity increased during the first 100 or 150 hours from 25 to 30 per cent., and the watts from 15 to 25 per cent., both then gradually decreasing. With some lamps expending at first 2·5 to 3 watts per candle there was no appreciable increase of luminous intensity, but rather a decrease of efficiency up to a period comprised between 300 and 500 hours when a consumption of from 4 to 4·5 watts per candle was reached, and remained unchanged even when the duration of the lamp exceeded 1,000 hours. From this he concluded that it was best to place the lamps in important positions during the earlier part of their service and afterwards to transfer them to positions where less light was required. From these experiments we may conclude that 4 watts per candle is the normal expenditure of electrical energy for incandescence lamps intended for a service of 1,000 hours.—*Revue Industrielle.*

AN INVESTIGATION WITH RÖNTGEN RAYS, ON GERMINATING PLANTS.

Mr. H. W. Webber, of the U.S. Department of Agriculture, writing to *Science*, says that the marked attention which the Röntgen or X rays are receiving from investigators of the United States and other countries, and the popular excitement felt in the investigations, render all papers on this subject of particular interest.

The first record of experiments with these rays in their effect on plants known to the writer is a recent article by Alfred Schober presented to the German Botanical Society.* Schober was led to the investigation by the similarity between X rays and ultra violet light, which was pointed out by Röntgen in his first paper. The subject appeared particularly worthy of investigation, as Sachs had shown that heliotropic curving is incited in plants by blue, violet and invisible ultra violet rays in about an equal degree with full white light; while the red, yellow and green parts of the spectrum are apparently inactive.

Rothert, in his very extensive work on heliotropism, found the cotyledo† of germinating oat plants to be particularly sensitive to the action of light, and these were thus selected for the experiment. Vigorous plants germinated in full light, with cotyledos from 1 to 2 centimetres long, were selected and set in damp sand in a dark box, the walls of which were about 1 centimetre thick and blackened on both sides. A Hittorf's tube was placed at one end of this box at the height of the seedlings and about one centimetre distant from the box. The seedlings were arranged at one end of the box so that they were about 2 centimetres distant from the tube. The inductor had a spark length of about 12 centimetres, and was kept at its highest capacity during the experiment. A photograph of a hand could have been taken under the same conditions at a distance of 30 centimetres in five minutes.

The plants were first exposed to the action of the rays for 30 minutes, after which an examination showed that no apparent effect had been produced. The box was then closed and the exposure continued for another half hour. A careful examination at the end of this time led to the conclusion that no visible effect had been produced. It was found impracticable to continue the experiment longer, as the tube in this time had become excessively heated.

After the experiment was concluded the plants used were proved to be normally sensitive, as an exposure of one hour to diffused daylight, passed through a small horizontal slit, resulted in a noticeable curvature which in four hours had reached 60° from the vertical.

* Schober, Alfred, "Ein Versuch mit Röntgenschen Strahlen auf Keimpflanzen." Berichte d. Deut. Bot. Gesellsch. Bd. 14, Heft 3 (April, 1896), p. 108.

† *Cotyledo* is a term introduced by Rothert (Cohns' Beiträge zur Biol. der Pflanzen, Bd. 7, p. 25) to designate the leaf-life organ of the form of an almost cylindrical closed sheath which appears first after the roots in the germination of grass seeds.

As the inductor was excited to its greatest capacity during the experiment, the plant being placed in as close proximity to the light as possible—and as after the experiment the plants were found to be normally sensitive, showing noticeable curvature on an equal exposure to diffuse white light—the author concludes that the new rays appear to differ from light in that they do not stimulate heliotropic curvature.

This contribution to our understanding of the action of the X rays on plants is very interesting, but it is not thoroughly satisfactory. While light induces a noticeable curvature on certain plants in one hour, the X rays may not be so active. Until it is possible to expose the plant to the action of the X rays for a longer time we are not justified in concluding that they have no power to induce heliotropic curvature.

TECHNICAL LITERATURE AT THE LAW COURTS.

Cassier's Magazine of last month contained an interesting article on the value of engineering publications in law suits.

In the course of an article anent the Muirhead *v.* Commercial Cable Company case some years ago, it was strongly urged that expert evidence as used at present was of but little value. In the course of this article the writer took occasion to suggest that something in the nature of sufficiently highly paid scientific advisers sitting on the bench with the judge (after the manner of the Trinity Masters in the Admiralty Court), would be more to the point than scientific witnesses on behalf of either side. It was also argued that in many instances it was not the best authorities in up to date practice that were employed as expert witnesses in a trial, but professional witnesses, so to speak, who traded on a name, a "presence," and a gift of speech, but whose evidence could not really be of the same value as that of the man constantly engaged at the time in the practice of the subject. Still, as a matter of fact, expert evidence is nowadays listened to by the judges more by way of technical education than for the individual opinions expressed on the merits of the case.

However—with Mr. Berg in the *Cassier's Magazine* article above alluded to—we now wish to call attention to the infinitely greater value of evidence from publications written some time previously, to personal evidence called in at the moment by either party. We venture to think that of late years this point has been somewhat lost sight of, and that books and periodicals have not been referred to and made use of in technical cases as much as they might have been. It will be obvious that matter written without any special set of conditions in mind, analysing the question in all its bearings, followed by a summary and accompanied by general recommendations, will offer the intrinsic advantage of representing the most independent opinion that it would be possible to obtain. From a legal aspect, for use in law suits or proceedings before commissioners, pertinent quotations from published works of leading authorities, or extracts from the technical press and proceedings of societies have the great value of standing in the light of the very best description of impartial evidence that could possibly be presented, having been written and published entirely independent of, and without any possible connection with, the matter under adjudication.

Absolutely untainted and independent testimony can probably be obtained only when experts are appointed and paid by the Court or the commissioners sitting in a case, by some such method as that above suggested, a form of which has been already largely in use in certain foreign countries. The views and reports of such men, backed up by quotations from previously published works of authorities and extracts from the technical press, should command respect and consideration; and, to our mind, these are the only reasonable methods of carrying on a legal enquiry.

Whilst touching on this subject we must not forget to allude to the highly reprehensible habit of extracting isolated sentences, or, still worse, parts of sentences from a book. This habit—largely indulged in over quotations from reviews—cannot be too severely condemned.

In drawing on technical literature to substantiate views to be expressed or promulgated by the expert, the entire drift of the argument employed by an author should be considered, as well as all the prevailing conditions and circumstances.

Our object here, however, has been to draw attention to the high value of literature and of the technical press in the light of a valuable adjunct to expert testimony, as well as an aid in designing and executing work.

TRACTION DIAGRAMS.

By THOMAS TOMLINSON, B.E.

If an engineer ordered to report on the relative performances of a number of engines widely different in speed, power, number of cylinders, type, &c., found that he had for data a number of indicator diagrams, some of which had no atmospheric line marked, some no indication of springs used, some no note of cylinder diameters, some no note of speed, and none any indication of the brake horse-power; that engineer would be in a very tight place for his report. And so am I, having undertaken to analyse and compare one with another such traction diagrams as are available, for the Electrical Review, under the impression that it would be a piece of very ordinary journey work, and now finding myself in face of just such a set of diagrams.

Traction diagrams so plotted, and with all the necessary data given as that they can be read with certainty and profit, exist, I suppose; I can only say I have not as yet come across them, and I have made reasonably diligent search. It is not enough that a traction diagram should show the variations in power used along a line, unless it also shows the variations in power needed.

The proprietors of the Electrical Review are endeavouring to procure for me diagrams in a form suitable for definite interpretation, and meantime I propose to consider the general question of such diagrams from the points of view of their production, interpretation, and utility.

The value of them appears to be strangely underrated, if we are to judge by the fact that they seldom appear now even in American papers, and still more by the existence of that absurd basis of comparison between line and line, the "cost per car mile:" the mere absence of traction diagrams from American periodicals—or, at any rate, their very infrequent appearance—would not of itself prove this; they might be so common as to be not worth giving, except in exceptional cases; but the "cost per car mile" as a basis of comparison, with a vague added note as to grades, does, I think, show that such is the fact, because such a basis of comparison, independent of grades, curves, speed, headway, and earnings (which mean stops and starts, which again mean energy), independent, in fact, of every engineering factor of the things compared, could scarcely be tolerated if engineers habitually "indicated" their lines as they do their engines.

Upon this "cost per car mile" basis, the New York *Street Railway Journal* for November, 1892, wrote: "That averages are a delusion and a snare is strikingly illustrated in the papers on 'Relative Cost of Operation of Different Systems (of Traction),' and emphasises what we have often said in regard to employing the car mile as a basis of comparison."

This is much too sweeping; but the spirit of it, that averages of the sort alluded to, mere arithmetical averages of things only superficially comparable, are a delusion, is certainly true.

In a comparatively recent number of the same periodical (December, 1895), the engineer to the Montreal Street Railway Company gives a table showing the calculated average drawbar pull per ton, month by month, as deduced from the station output. I have not yet gone into the question of how it is deduced, but it is certainly a move in the right direction towards an engineer's basis of comparison; not a clerk's.

Assuming for the moment that it is possible to compare the traction diagram of a given run with the actual demands made by the run—that is to say, to compare our diagram of current or E.H.P. with the corresponding curve of drawbar

pull or B.H.P. required, it is worth while to enquire why it is not done, or rather not recorded?

An examination of these diagrams as they are usually given—that is to say, as taken with an ammeter, a voltmeter, a watch, and (sometimes) a speed indicator, and plotted to a base line of time, leads, I think, to these conclusions:—They are neglected because they are useless; they are useless because they are plotted to a wrong base line (time), which necessarily cuts them adrift from any practical connection with the one thing which above all else determines their form, the actual line to which they refer; you can't very well plot a section to a time base. They are observed and plotted to a time base because the base line to which the traction formula refers (in the form in which it is usually used) is an imaginary line (the horizontal base line of the line section) having no visible points of reference. (See an account of a trial of the "Electric Locomotive at Baltimore" in the *Street Railway Journal* for May, 1896, for a graphic instance of the difficulties in which this lands you.) Points of reference could be provided just as the railways have mile and grade posts, but in general the tramway engineer will not have either the time or the means for doing it.

In fact, we come ultimately to this—as the root of the matter—that in the traction formula as usually used,

$$\text{Power (per ton)} = [p \pm 2{,}240 \times \text{grade}]\, v.$$

v is the velocity in feet per second measured along the horizontal base line of the plotted section of the line, and it requires the mile and grade posts of the railway to make it of practical use in experimental work on an existing line: these not being available in tramway work, the readings of ammeter and voltmeter for the traction diagram are usually taken at time intervals; this cuts the traction diagram, as got from the readings, adrift from the traction diagram as got from the line, and makes the former useless, and therefore neglected; hence I take it the "cost per car mile" basis.

Now there is not the slightest necessity to use the traction formula in that particular form, so suitable for the *à priori* investigation of power upon a proposed line, of which the section only is available, and so entirely unsuitable for the practical investigation of power variation upon an existing line, with perhaps no section available; it can be used in another form, which readily lends itself to the latter purpose. This form is

$$\text{Power (per ton)} = (p \cos\theta \pm 2{,}240 \sin\theta)\, v_1$$

where v_1 is speed in feet per second along the grade, p, as before the traction in pounds per ton, due to friction, and θ the angle of the grade.

Using the formula in this form, we have a visible rational base line, points on which can be connected with the corresponding readings by a speed counter on an axle of the car (the wheels on this axle must not be so braked as to skid), or on an axle and pair of wheels drawn or pushed by the car.

Traction diagrams observed and plotted to this base line have—as I shall show—the advantage of being comparable, point by point, with the diagram representing the demands of the line, and not merely the demands of the line upon some supposed value of p, but upon the actual value for the particular run, and, moreover, not merely the dead drawbar pull upon the supposition of unvarying speed; but the drawbar pull, as it is modified by the actual conditions of the run—here increased as the car quickens its speed, here diminished as it slows down. In fact, we can superpose the two diagrams and compare directly point by point current with drawbar pull, and E.H.P. with B.H.P.

The simplest way of treating the matter will be to suppose ourselves about to investigate the traction diagrams of a given line, and, as far as possible, without recourse to any expensive or complicated means.

For this purpose, we must first get the theoretical diagram on the assumption that the line is without curves.

Take a car and connect to one axle of it, from which the brake blocks have been removed, a speed counter so geared that it registers feet of advance of the car, and a speed indicator so geared that it indicates speed in feet per second, making such an opening in the floor as shall allow the dials to be seen.

If a plan and section of the line are available, we must by calculation find the actual length along the grades, and plot as base line, the extended length with the beginning and end of all curves and grades marked on it, and we must calculate the values of $\cos\theta$ and $\sin\theta$ for the grades.

If no section and plan of the line be available (and, perhaps, preferably, even if there be), we may proceed thus:—Take a sheet of double elephant and mount it on a drawing board, midway down its longest length draw a vertical line, (A F, in fig. 1), and from a point on this line draw two circles with radii 35 inches and 31¼ inches representing lengths 2,240 and 2,000 to scale $\frac{1}{64}$th inch; divide and mark these circles so that the divisions on the circle with 31¼ inches radius represent, in $\frac{1}{64}$th, the value of 2,000 multiplied by the cosine of the angle, θ, made by the radius with the vertical, and the divisions on the circle with 35 inches radius represent the value of 2,240 multiplied by the sine of the same angle, θ.

This will be found to involve only the scaling of line lengths, and will be much facilitated if the circles are drawn upon squared paper (double elephant size).

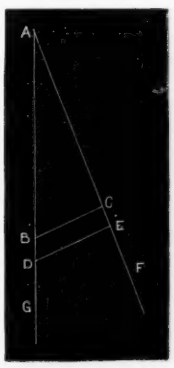
Set up the drawing board upon a rigid framework with feet at right angles to the plane of the board, and so long as to reach from seat to seat of the car, and with means for fixing them to the seats. Let the framework be of such height, that an observer sitting on the tramcar seat with the plane of the board placed longitudinally to the car has the circles at about the level of his eyes. Suspend from the centre of the circular scales a plumb line of light steel wire, with a heavy weight attached, and set the board so that the vertical line on it coincides with the plumb line when the car is on a dead level.

The springs of the car should be blocked so as to allow no movement of the plumb line, except that due to grade.

In fig. 1: A is the point of suspension, A D = 2,240 (to scale $\frac{1}{64}$th inch). A B = 2,000 (to same scale); A F is the vertical line, A G is the plumb line, F A G is the angle of the grade.

$$\text{A C} = 2{,}000 \cos\theta.$$
$$\text{D E} = 2{,}240 \sin\theta.$$

The values of A C and D E are marked on the circles described with A B and A D as radii.



D E represents the actual value in pounds of the drawbar pull per ton due to grade; the variations of A C represent (to a very exaggerated scale, since p in only 20 to 30 instead of 2,000), the variations in the drawbar pull due to friction, modified by grade. Practically we may neglect these latter variations; but it is as well to keep before us the fact that they exist.

If the car be now slowly drawn along the line (the grooves being thoroughly cleaned in front of it) and the readings of the speed counter with the corresponding values of A C and D E be recorded, as also the readings of the speed counter when the leading wheels take the curves, and when the trailing wheels leave them (since the action of the curve in increasing resistance are pretty sure to extend over the distance thus represented); we have data for plotting the theoretical traction diagram of the line—so far as resistances due to friction and grade are concerned—to a base line representing the surface length of line, provided we know the value of p; and we have also data for marking on our base line the beginnings and endings of the curves, so that although we may not know at the start the influence of curves of different radii upon the theoretical diagram, we can see the effect upon our electrical traction diagram, and thence arrive at sound general conclusions as to what the effect is.

D

The value of $p \cos \theta$ is always positive; the value of $2{,}240 \sin \theta$ is positive on an up grade (*i.e.*, when the plumb swings to that side of the vertical opposite to the direction of motion), and negative on a down grade.

This experiment, necessitating a very slow speed, would have to be made at night after the station had shut down, and the car would have to be hauled by animal power, and it would, perhaps, increase its value if a dynamometer were interposed.

The pull in rounding curves should, in this case, be applied in the direction of the driving, and not in the way in which a pair of tram horses drag a car round a curve; this must lower the resistance considerably as compared to its value with power applied at the wheel circumference. But, indeed, it would be unwise to lay much stress upon an isolated dynamometer value of such a varying factor as p.

Its value can be approximately determined for future guidance by noting those grades down which the car slides with little or no acceleration. When the acceleration is nothing, then

$$p \cos \theta = 2{,}240 \sin \theta,$$

and

$$p = 2{,}240 \tan \theta.$$

It can, however, be best determined as the mean of a series of observations of the speed indicator and speed counter on straight lengths of line of known grades, thus :—If v and v_1 be the velocities in feet per second when the counter reads c and c_1 in feet, if W be the weight of car and passengers in tons, and if the current be off when both c and c_1 are observed, then

$$\text{W} \times \frac{2{,}240}{2\,g} (v^2 - v_1{}^2) = \text{W} (c_1 - c) (p \cos \theta \pm 2{,}240 \sin \theta),$$

and as W divides out, we don't even need to know weight of car.

The great value of this formula is that it will enable us by observation of our traction diagrams to get the value of p for the particular state of rails existing when the diagram is taken. That is to say, we may mark in any way we please three or four straight down grades at different parts of the line—grades not much above that on which the car rolls without acceleration, and if these grades are run without current we can, from the values of v and c as read off, and the values of $\cos \theta$ and $\sin \theta$ as known, get for that particular diagram the mean value of p. This is infinitely preferable to referring our electrical traction curve to a theoretical traction curve based upon a value of p, which perhaps does not hold at all in that particular case.

There is, of course, work done in the acceleration of the armatures on their own spindles, which does not vary with the weight of the car. It may be expressed in this form :—

$$\frac{\text{W} \times 2{,}240}{2\,g} \times a\, b^2 \times (v^2 - v_1{}^2),$$

where a is a small fractional variable depending upon the variation of weight of car and passengers, and b is a constant depending upon the gearing, W being weight of car.

A consideration of this factor may be of importance in connection with comparisons of single reduction and direct driving; but we may neglect it, I think, for the present anyway. Its effect is to slightly increase the value of p, as deduced, above its real value.

(*To be continued.*)

BUDA PESTH CONFERENCE, 1896.

Our last issue contained a list of the representatives of the various administrations and private companies attending the Conference, and the following is a condensed extract from the *Journal Telegraphique* of the proceedings, in accordance with Article 15 of the St. Petersburg Convention, since the opening of business in the great hall of the Academy of Science at Buda Pesth.

In the opening remarks, His Excellency the Minister of Commerce, M. Ernest Daniel de Szamosujvár-Németi, supported by the Under-Secretary of State, M. Ladislas Vörös, said that it was with the liveliest satisfaction he received the delegates, and offered them the heartiest greetings and welcome. This meeting was in accord with, and would be engraved on his Excellency's memory as coming on the anniversary of the 1,000th year of the political existence of Hungary. He admitted that besides the political existence of his country he had at heart the interests of science and the development of those institutions destined to effect the economical relationship of all humanity; hence there followed this international telegraphic meeting.

In the foremost rank in the service of commerce he would place posts, telegraphs, and telephones. In industry, railways and navigation. Telegraphs and telephones taking the first place in intellectual communications, have the greatest interest.

A proposition of international tariff reform had been made by one of the most important administrations, and he had no doubt that this and other propositions would be solved in accordance with general interest, and the consideration of the regulation would result in the acceptance of those most useful and least prejudicial.

The eighth Telegraphic International Conference having then been declared opened, M. Raymond, the French delegate, replied in accordance with the established rules, thanking in suitable terms the Minister of Commerce for the welcome offered to himself and other delegates.

Mr. Fischer, the British delegate, as the *doyen* of the representatives, also replied in the same strain, and after these complimentary speeches had been delivered, M. Szalay, as the President, opened the business of the day in the usual manner, and with the reiteration of Magyar hospitality.

A long list of those who had died since the last Conference in Paris, in 1890, was with every respect and sympathy enumerated.

New adhesions of States were stated to be as follows :—Chili, Ecuador, Mexico, Salvador, Venezuela.

The President expressed satisfaction at the presence at this Conference of the delegates of these countries, and upon concluding the adoption of the regulation summoning the Conference, the representative of Venezuela requested to be allowed to address the meeting. He said that his Government had the greatest sympathy with the objects of the International Telegraph Union, and that an exhaustive examination of the regulations had been made by the Minister of Foreign Affairs, and the Minister of Public Works, to ascertain if they came into conflict with the rules already laid down for the working of the telegraph lines in his Republic. He stated that the Yellow Book now presented showed that the examination led to the conclusion that several regulations in the St. Petersburg Convention, especially Article IV., would impose obligations on his State to establish a special cable, besides other lines, the construction of which required a capital which at present would be unproductive, on account of this it had been decided by his State to postpone their entry until the development of the commerce of Venezuela justified this expense.

According to the rules, the president's proposition then decreed that the Bureau de la Conference would be constituted as follows :—

M. le Dr. Rothen to assist the President with his great knowledge and experience; M. Sigismund Schrimp, vice-president; M. Eschbaccher, general secretary; M. le Dr. Hennyei, Balla and Homberger, assistant secretaries.

The Bureau having thus been constituted, the President requested the French delegate, as the head of the last Administration, to give them the records of matters of common interest which had occurred since the last Conference held in Paris.

M. Raymond said all Governments participating in the International Telegraphic Convention having given their adhesion at the time requested, the regulations and the tariffs considered at Paris on June 21st, 1890, came into vigour on July 1st, the following year, as agreed upon. The following had declared their adhesion :—

States.—West Australia, from January 1st, 1894; Portuguese Colonies, from January 1st, 1894; New Caledonia, from January 1st, 1895; Queensland, from April 9th, 1896.

Companies.—Telegraph and Telephone Company of La Plata, from March, 1891; South American Cable Company, from December, 1892; Halifax and Bermuda Cable Company, from January, 1895.

Compagnie Française des Cables Télégraphiques, constituted by the fusion of the Compagnie du Télégraphe de Paris à New York with the Société Française des Télégraphes Sous-

marins, had declared its adherence to the Union, so far as their cable from Bundaberg, Queensland, to Ouaca (New Caledonia), was concerned.

The various adhesions were made known by the contracting offices through diplomatic sources to the Bureau International.

The South American Republic and the Orange Free State have been disposed to consider the question of entering, and were inclined to answer in the affirmative; but these two States, for various motives, have had to abstain until the present from carrying their desire to enter into effect.

Other States have not replied, and have said their decision has been deferred.

The Telegraph Administrations of Chili, Ecuador, Mexico, Salvador and Venezuela, which are officially represented at this Conference, give evidence that their Government is in principle favourably inclined to the accession to the Union. The representatives of these administrations will certainly use their great influence to persuade their country to give their formal adhesion, and in particular, you have understood the Venezuelan representative, in his interesting speech, to say that he will give his best assistance to his Government.

I am sure it is the desire of all to give expression of our confidence in the Hungarian Government that the duties transferred from France to-day to accord the privileges contained in Article XVIII., under which the Telegraph Union must grow, will be properly carried out.

As in preceding Conferences, the preliminary work has been confided to Commissioners for regulations and for tariffs, as well as the new additions, and the Commission for compilation or editorship.

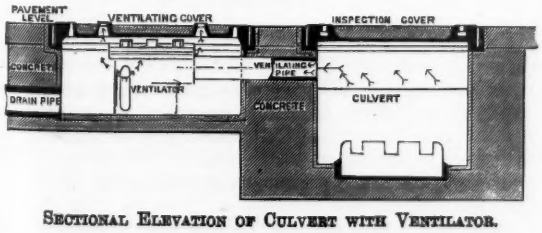
The Commissioners for regulations have been selected from the following:—Germany, Austria, Belgium, Bulgaria, Spain, France, Great Britain, Hungary, Dutch India, Italy, Japan, Norway, Holland, Portugal, Roumania, Russia, Sweden and Turkey.

Commission for tariffs composed of delegates of Germany, Austria, Belgium, Brazil, Bulgaria, Denmark, Spain, France, Great Britain, Greece, Hungary, British India, Dutch India, Italy, Japan, Luxembourg, Norway, Holland, Persia, Roumania, Russia, Servia, Sweden, Switzerland and Turkey.

As far as the Commission for compilation is concerned, it has been made up of the delegates of Germany, Austria, Belgium, France, Great Britain, Italy, Holland, Roumania. The sitting was closed in order to pass a resolution of sympathy in favour of the late Director of Telegraphs, M. Koller de Grazow, who died since the last Paris Conference.

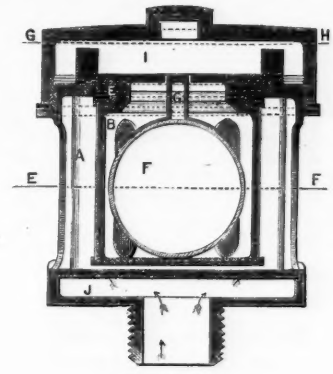
PENSON'S CONCENTRIC VENTILATOR FOR TRANSFORMER BOXES.

There is little doubt of the importance of an adequate ventilation of transformer boxes and culverts. But ventilation must be secured without any risk of flooding, and central station engineers know how few systems there are that combine these advantages. Mr. Penson's system, which we describe below, is certainly ingenious, but actual practice alone can determine its value.

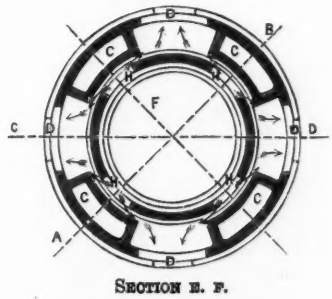


Sectional Elevation of Culvert with Ventilator.

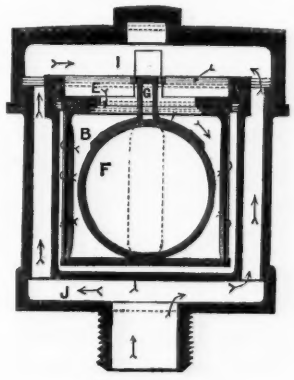
The ventilator consists of two brass chambers, A and B, placed concentrically to each other, the outer one, A, having passages C, C, C, C, communicating with the transformer box, and also slots, D, D, D, D, open to the atmosphere, there being no communication between C and D, except through the opening in the inner top cap, E, and the slots, H, H, H, H, in the inner chambers, B. This chamber contains an inflated rubber ball, F, on which rests a valve, G, which in the event of flooding is forced into its coned ground seating in the inner top cap, E, by the rising of the ball, F, thus preventing water from getting into the transformer box. A piece of



Section C. D.



Section E. F.



Section A. B.

Section G. H.

A, Outer chamber; B, Inner chamber; C, Passages communicating with box, E; D, Slots open to atmosphere; E, Inner top cap; F, Inflated rubber ball; G, Valve; H, Slots in inner chamber; I, Outer top cap; J, Bottom cap.

wire gauze is fixed round the outer periphery of the chamber B, which serves as a protection for the valve from grit. The interior of the ventilator can be easily examined by the removal of the outer and inner top caps, I and E.

To thoroughly ventilate a transformer box, it is necessary to have two ventilators, to one of which is attached a rubber

tube or other pipe going to the bottom of the box through which cool air is drawn in, the heated air being discharged through the other. By this means it is claimed that a thorough circulation is established and all difficulties from the accumulation of gas in the boxes and sweating of the iron are overcome.

The principle of the ventilator for culverts is similar to the above but varies slightly in design. In this case no valve is employed, the ball itself sealing the opening into the culvert.

REVIEWS.

Submarine Cable Laying and Repairing. By H. D. Wilkinson, M.I.E.E. The *Electrician* Printing and Publishing Company, Limited, Salisbury Court, Fleet Street, E.C.

(*Continued from page* 9.)

When describing Captain Thomson's log on page 370, Mr. Wilkinson makes no mention of one of its most important features; the fact that it will register correctly at far slower speeds than any log which is towed in the ordinary way through its being supported and kept from sinking vertically in the water. Another convenient thing is that it never requires to be hauled in on the ship being put astern. However the ship may be turned about the log is always ready for work. When taking soundings at short distances this is particularly valuable, as it is impossible to measure correctly if the log has to be hauled in before the ship is stopped and streamed after she is underway. The following paragraph, *apropos* to all logs, occurs in "Remarks on Ocean Currents, &c.," by Anthony S. Thomson—a paper communicated to the Geographical Congress of last year—and is worth quoting: "Whatever be the kind of patent log used, its indications should be carefully checked from time to time by comparing them with the 'Dutchman's log' at different speeds whenever any current observations are to be made. Empty bottles answer admirably for this purpose when ballasted with a little water. The observer, who stands on the bridge with a stop-watch, requires three assistants, one to throw the bottle ahead of the ship, one to dip a hand-flag as the bottle passes his marks at the stem, and another to do the same thing when the bottle passes his marks at the stern. It is convenient to read the revolution indicator and the bridge log before and after timing the bottle, with an interval of six minutes between the two sets of readings. When a number of such observations are carried out with care, the mean results will give the ship's speed through the water very accurately, and the percentage of error of the log at the given speed is easily ascertained and allowed for."

There is also much valuable information in this paper relating to navigational matters which is well worth reproduction, but for which we cannot afford space.

We now come to the design and manufacture of cables, which is Chapter IV., page 271, and we are told in the first three lines that there are mechanical and electrical considerations; the former simple, but the latter requiring considerable experience and skill, especially for long cables. This is by no means correct, the mechanical considerations are, in our opinion, exceedingly complex, and since the very existence of a cable depends on the sheathing successfully battling with the many agencies constantly at work against it, must be of paramount importance. The sheathing of even the latest Atlantics can only be considered as a compromise—vastly superior as it is to that of the earlier types. It was Brunel, we believe, who was responsible for the design of the sheathing of the first Atlantic cable, which, although an admirable type on many accounts, failed completely to resist oxidation. By the way, it is interesting to remark that although soon after the failure of this cable attempts were made to recover it from shallow water, which failed through the cable being at many places rusted through, no attempt appears to have been made to recover the deep water parts which would then have been in comparatively good condition.

Any type of cable must be a compromise more or less. Some designs, while securing long life, result in a cable which may be troublesome to lay and to repair, and the combination of iron or steel with hemp or jute, which materials are now universally adopted, is a difficult one to arrange. At the end of April last year, in a short article on nickel-steel wire, we drew attention to the importance of well galvanising the wire of a submarine cable. It is, perhaps, open to question whether the money expended in outside servings and compounds would not often be better utilised in giving an extra thick coat of zinc. This would mean increased difficulties in laying, no doubt, but they should be got over. There seems to have been no improvement of late years in the machinery used for laying cables. The same kind of brakes as originally used are still to be seen, though we have never heard anyone dispute that they are not a long way short of perfection. Manufacturers are, perhaps, inclined—and naturally—to attach too much importance to a cable being one that can be laid without difficulty.

(*To be continued.*)

Ministry of Posts and Telegraphs: Statistical Relation concerning the Postal and Telegraphic Services for the Official Season, 1894-95, *and the Service of the Post-Office Savings Banks for the year* 1894.* Rome: The Co-operative Printing Union, 1896.

The first part of this report gives a full account of the staff and the offices of the postal and telegraphic service in the kingdom of Italy, preceded by a general introduction on the innovations in the services, and followed by a very minute account of the income and expenditure of the departments. It is satisfactory to find that these departments are not working at a loss, and that, as compared with the previous season (1893-94), their position is improving. The innovations are satisfactory to a small extent, though we find no promise of anything beyond the meagre standard of the "postal union," which, taking weight and cost into consideration, is five times less liberal than that of Britain. But in this direction wealthier states than Italy, *e.g.*, France, Germany, and the United States of America ought to lead the way. The second chapter treats of the correspondence entrusted to the post, the parcel service, the transport of postal matter on common roads and on tramlines, and postal and commercial maritime service.

The post-offices of different grades amount to 7,192.

In the chapter on telegraphs and telephones, we see that the simple Morse apparatus have, since 1885, increased from 3,074 to 4,827. The simple Hughes apparatus, which in 1885 were 74, are now 181, and the duplex Hughes, which were first introduced in the season 1893-94, are now 16 in number. The apparatus of the Wheatstone groups are: complete, 12; for transmission only, 6; receiving only, 68; and the Bandlot duplex apparatus are 11 and the quadruplex 6. The entire number of elements is 200,500, and of accumulators, introduced in the season 1893-94, 2,507.

The entire number of persons employed is 7,779. This is a reduction, as in the season 1893-1894 it was 8,013.

Of the inland telegrams forwarded in 1893-1894, 40·97 per cent. were on affairs of the bourse and of commerce; 3·53 on political matters; 28·56 on family affairs; 26 30 on various affairs, and 0·64 were in cipher. These proportions differed little in the season 1894-1895. The foreign telegrams dispatched in the season 1894-1895 were on affairs of the bourse and commerce, 55·52; political, 4·30; family matters, 19·31; sundry affairs, 19·89; and in cipher, 0·98.

* Ministero delle Poste e dei Telegraphi: Relazione Statistica intorno al Servizi postale e telegraphico per l'Esercizio 1894-95 ed al Servizio delle Casse postali di Risparnio per l'Anno, 1894.

"CAVEAT VENDOR."

It is not always, Horatius Flaccus to the contrary, notwithstanding, that club-footed justice overtakes the evil doer. But with Lord Russell and a British jury as crutch, it would appear to have done so in the case of Oetzmann and Co. *v.* H. F. Long & Co., which was decided on Monday last.

The decision in this case is of considerable importance to industry and commerce in general, and, in certain respects, to the electrical industry in particular.

The facts brought out in the evidence were to the effect that a certain buyer in the employ of Messrs. Oetzmann and

Co., of Hampstead Road, resorted to the practice of asking, or accepting, commissions for his personal benefit from the defendants, a firm of Sheffield cutlers, with whom he placed orders for cutlery on behalf of Messrs. Oetzmann. The consequence of this was, that his employers paid more for the goods so purchased than current market prices. On his death bed he made confession of his unworthy stewardship. This has a sound of the Sunday-School pamphlet, but is nevertheless true; and Messrs. Oetzmann, having obtained confirmation, by means of a letter written under an assumed name, of the readiness of the defendants to subsidise their late buyer's successor, sued Messrs. H. F. Long and Co. for overcharges and commissions paid to their late buyer. It was proved that one of the partners of the defendants firm was privy to, if he did not initiate, the illicit transactions referred to.

The jury found that the defendants had been party to a corrupt bargain with the plaintiffs' previous buyer; and the Lord Chief Justice gave judgment against the defendants, ordering them to make good to the plaintiffs the losses they had incurred by reason of the corrupt bargain, and also the commission paid to the plaintiffs' previous buyer.

The significance of this decision is enhanced by the comments which fell from Lord Russell in the course of his summing up. He is reported to have said:—

"These corrupt bargains were malignant cankers. It was a system dishonest to the fair trader, dishonest to the fair employer. If the evil continued to exist as it had existed in the past, the Legislature must take measures to cut out the canker. It was unnecessary to point out how the evils worked; they operated to the detriment of the honest trader, who was above such nefarious practices."

These are pregnant words, and point to the growth of a new temper in the socio-industrial organism. We have grown so hardened to the formula of *caveat emptor*, that we survey with equanimity the spectacle of the buyer being alone called upon to carry on his back all the responsibilities of a bargain; and as the buyer is more often than not the public, we have come to see nothing illogical in the vision of an individual who has employed the greater part of the week in, say, unloading stocks at prices which he knows to be fictitious upon a public less well posted, attending Divine Service on the seventh day, with a beatified expression suggestive of thankfulness that he is not as other men are.

But Lord Russell and his jury mark another milestone on the path which the Legislature, in response to public opinion, are treading, and which leads to the modified doctrine *caveat vendor* as a supplement to *caveat emptor*.

Philosophers who rely on natural evolutionary processes for the ultimate attainment of human perfection, would probably tell us that society is on the wrong road, and that no good can come of protecting the guileless and unwary. We fancy, too, that many "business" men may feel some bewilderment in trying to understand why Messrs. Oetzmann should be recouped for the fact of having in their employ a dishonest servant, who apparently occasioned them losses because they did not supervise his dealings sufficiently closely to discover that they were buying at a disadvantage.

Without indulging in an academical analysis of this question, however, we may assume that thoughtful people are inclining to the opinion that the retributive sword of Justice should descend as surely upon the rogue as the fool, and that dishonest practices on the part of a seller are not to be condoned because they are acquiesced in by an unwary buyer.

That the system of corrupt secret profits and personal commissions has attained to serious proportions in commerce and industry, no business man in a position to judge will deny; but that the practice exists to any grave extent in other departments of the nation's life is fortunately doubtful. Students of history know that there was a time in merry England when to conciliate the judiciary before trial of a cause, was as usual a condition precedent to securing "justice" as it still is in many countries not so far afield. Mr. Samuel Pepys has also naïvely enlightened us as to the substantial scale upon which something of the sort existed among highly-placed State officials in his day. But on the whole we know we have reason as a people to congratulate ourselves upon an exceptionally clean-handed public service.

But in the departments of industry and commerce there are those, and the Lord Chief Justice is evidently one, who think that this "malignant canker" in a nation's body politic is on the increase. No man placed in a position where he has favours to bestow or receive can hope to escape having to face the evil; and men of integrity holding fiduciary positions as administrators of the capital of others, as, for example, the executive *personnel* of public companies, often find themselves in great difficulties as to how they shall preserve at once their clients interests and their personal conceptions of right dealing.

Whether the practice is really extending in the directions named it is difficult to say; but there is no doubt that foreign competition, both within and without our gates, and the increasing difficulty of carrying on business remuneratively, accentuates the temptations to which men are subjected. In the electrical industry this liability is not lessened by the intricate character of the business, and the conditions under which many of the more important works have to be executed.

There can be no doubt that an effort on the part of the Legislature, as the supreme index of the best popular opinion, to deal with the evil, as suggested by Lord Russell, would be welcomed by all right thinking men; for, though men may not be made perfect by Act of Parliament, attention would thereby be called to the matter, and an improved popular opinion possibly created. Meantime the lesson, and it is one of great importance, which appears to stand out clear from the recent decision in Oetzmann & Co. *v.* H. F. Long & Co., is this: that inasmuch as any dealings between a buyer's representative and a seller's representative which are in restraint of fair and open trading between the principal interests, are opposed to public policy, the seller's agent may bring himself within the clutch of the law as much by promoting corrupt or dishonest practices as the buyer's agent in acquiescing in them; and that any party, be he buyer or seller, who steps in to defeat the intention of the law by resort to corrupt practices, renders himself liable to restore to the interests prejudiced the loss and damages resulting from his action.

CORRESPONDENCE.

"The Pull of a Horse."

I notice in your article upon motor carriages you ask from anyone who has tried it, "any dynamometer tests which will show at given speeds the tractive pull of a horse on an ordinary carriage?"

I cannot give them on a carriage, but I can tell you what I got 13 years ago when testing the work of some of the finest draught horses, 16½ to 17 hands, in the Cleveland mines—and showing probably the best work to be got from any horse.

A discussion had arisen at the Northern Mining Institute, and a gentleman, speaking in favour of feeding with maize, had compared the work of horses carting night soil in Newcastle with the work of these mine horses fed upon oats and beans—to the advantage of the former.

I therefore fitted up a dynamometer and tried it. This machine consisted of one of the spring weigh machines of Messrs. Pooley, to the pointer of which was attached a pencil which registered the pull in pounds, upon a sheet of paper fastened round a drum; this latter was slowly lowered by an air cataract, during the time that the horse travelled a given distance.

I got many diagrams under varying conditions, but found it impossible to make any comparison with the cart horses whose work in Newcastle was mostly down hill to the railway siding, and the journeys of considerable length, whilst the mine horses seldom travelled more than 200 yards, but pulled heavy loads in waggons at their full strength. For instance, in a special test experiment: One diagram showed that the horse with a draught of 648·53 lbs. at 4·62 feet per second = 2,996 foot pounds per second, had travelled 138·6 feet, doing the work of 5·44 conventional H.P. The accuracy of the dynamometer was tested by weights, and the diagrams measured by planimeter.

Tramway horses are not so powerful as these horses, but I have no doubt that for their size each time a tram starts they exert a relatively large amount of strength—probably not less than 3¾ H.P. At the period of which I am speaking, I looked up all the information available on the subject,

and carefully read "Expériences sur le Tirage des Voitures," by Arthur Morin.

The only record I have found of work done by a horse comparable with that given above, is in Morin's "Mechanics" in some mail boat experiments, when the horses were called upon during one or two minutes to make an effort of 205·66 lbs. at a speed of 13·84 feet per second equal to 2,846 foot lbs. per second, whence, says Morin, results straining of the hams and other accidents.

A. L. Steavenson.

Efficiency of Transformers.

The latest published matter dealing with the question of transformer efficiencies is, presumably, to be found under this heading in Mr. H. F. Berry's paper on "Alternate Current Transformers," of which a reprint is appearing in your columns.

Without attempting to criticise the paper as a whole, I believe this question of efficiency to be of so much importance at the present time, that I trust the author will forgive me if, by pointing out the error of his reasoning, I am able to throw more light on what still appears to be a somewhat doubtful point.

Mr. Berry publishes a formula for the efficiency of a transformer, which he finds satisfactorily agrees with the results of tests carried out by himself.

Let W = watts lost on open secondary circuit.

E_s = secondary volts on open circuit.

E_l = secondary volts when a current, C_l, is taken out of secondary.

Then, on the assumption that the primary E.M.F. is constant, and the load non-inductive, the efficiency is represented by the expression :

$$\frac{E_l\, C_l}{E_s\, C_l + W}.$$

It will be observed that this assumes the voltage drop due to magnetic leakage to be just as intimately connected with loss of power as the drop due to ohmic resistance of the coils. That this formula is of great practical utility the author does not appear to doubt. Had he not, however, taken it for granted that the secondary of a transformer has self-induction, even when supplying current through a non-inductive resistance, he would have seen that his formula, instead of being merely an empirical one approximately in accordance with the results of a limited number of experiments, is really in such perfect agreement with our present theoretical knowledge as to warrant its being adopted as one of the most exact methods —if not the most exact method—of measuring transformer efficiencies.

In the column and a half of printed matter, presumably in explanation of the above formula, Mr. Berry shifts his point of view so many times, and says so much that is either obscure or inaccurate, and so little that can be easily assimilated by the lay mind, that it is difficult to see exactly where he begins to go wrong.

At the end of the first column, however, the author sums up what has gone before. He says that "Leakage, it will be seen, must cause a self-induced E.M.F. in the secondary coil, and, consequently, expended watts are to be represented by the expression $\nu A \cos \alpha$." We are not told why this is so; nor are we told what is meant by ν, or by A, or by α. But α is undoubtedly an angle; if it is an angle, let us suppose it is 90°! if it is 90° it matters little what ν and A stand for, because nothing will prevent the expended watts being represented by zero.

The truly wonderful thing about this is that a few paragraphs further on the author goes out of his way to prove, by means of a diagram, that the drop in the secondary coil due to leakage of magnetism does *not* represent loss of energy.

All this is a little bewildering; and it is surprising that Mr. Berry, on finding that his theory would not adapt itself to the results of his experiments, did not stop to question the soundness of it, or to consider where it might be leading him astray. I think it is a pity that he should consider geometrical proofs of problems to be so far beneath the notice of a mind imbued with theory; as there can be no doubt that had he been more accustomed to the use of diagrams, he could never have represented (as he does in his fig. 1) two magnetic streams flowing against each other through the same section of iron.

Although the days when I considered alternating current problems to be "not in the least difficult" are now dead and buried, along with many another pleasant illusion of my early youth, I cannot help thinking that this question of magnetic leakage in transformers is really not such a complicated one as it is frequently supposed to be.

Without denying that, in a specially badly designed transformer, there *may* be a slight amount of self-induction in the secondary circuit, even when closed through a non-inductive resistance, it seems to me contrary to all our ideas of force and motion to conceive of the *secondary* coil of a transformer creating its own magnetism.

Surely what takes place is this :—The impressed volts on the primary terminals being constant, the flux through the primary core is independent of the load, except for the slight reduction of the effective volts due to ohmic resistance of the winding; but if there is leakage, all the flux generated by the primary does not go through the secondary coil, therefore, since the leakage magnetism will increase with the increase of the total primary current, it follows that at full load there are still fewer lines through the secondary core than there were on open circuit.

Result.—A drop in secondary volts over and above that due to the ohmic resistance of both coils. Also, since that portion of the secondary drop which is not due to ohmic resistance is the result of an E.M.F. in the primary circuit *exactly in opposition to that component of the primary current which balances the secondary current*, it follows that it involves an expenditure of power equal to the product of the secondary current into the total leakage drop. Hence the results of Mr. Berry's experiments, instead of adapting themselves to the assumption that there is a back E.M.F. in the secondary circuit, are the strongest proof of the contrary which has ever been published.

Alfred Still.

June, 1896.

Charging for Electric Current.

I was very pleased to read Mr. Warren Lewis's reply to Mr. Farnsworth's paper on "Charging for Electric Current," which has recently appeared in the *Electrical Engineer* of N.Y., as it is the first real criticism of systems of differential charges for electricity on other grounds than that of complexity that has come to my notice.

The whole basis of Mr. Warren Lewis's criticism appears to rest on his assumption that there is an analogy between the supply of electricity from a central station and the selling of ordinary commodities from a dry goods store. Now, in the first place, I entirely dispute such an analogy, in fact, I find it very difficult to instance the case of any other commodity which is manufactured and distributed under any conditions at all similar to those appertaining to the production and supply of electricity. Take the case of a dry goods store or gas works—their commodities can be taken from stock when required, and consequently the cost of production is not materially affected by the varying rate of consumption during the day, whereas with electricity this, in practice, has to be produced at the same instant as it is required for use as it does not pay for stocking.

If the dry goods storekeeper found that all his customers insisted upon doing their shopping during a period of say, two hours out of the 24, and, moreover, required all the goods should be made on the spot while they wait, the analogy would be more complete. The supply of electricity is, Mr. Lewis's contentions notwithstanding, more of the nature of the distribution of a privilege than of a commodity, owing to the proportionally enormous cost of getting ready to supply compared with the actual cost of the materials consumed in continuing to supply.

In practice, the great proportion of the cost of electricity is the hire of the plant and mains. A far nearer analogy is to be found in the telephone service, for the use of which it is considered equitable and commercially expedient to charge a fixed rental for the purpose of covering the proportionally heavy standing charges, rather than by a unit charge per message, which method would be based on the cost of the services of the operators.

Another analogy, although far from perfect, is to be found

in the differential rates of charging for the privilege of exclusively hiring many things, such as vehicles, machines, &c., in which cases it is generally considered sound and equitable to reduce the rate of charge the longer the plant is used. To take the example of the cab, it is customary to pay a very high rate per hour for short journeys compared with the rate per hour if the vehicle be engaged by the day.

Mr. Lewis practically acknowledges the value of differential charges by admitting that such a method is a good one for co-operative or municipal electricity supply stations, but he has unfortunately implied that the cost of supplying a unit of electricity is the same to all the consumers as evidenced by the last two paragraphs of his letter, wherein he states "that on a kilowatt hour basis a station manager should certainly know what a kilowatt-hour costs delivered"; how is this possible except by assuming it is equal to the average cost of all the units supplied from the station? And again, "the expense of producing one unit belongs wholly to the producer." Surely Mr. Lewis would not argue that it costs a company just as much to supply 1,000 units to a consumer using 10 lamps 10 hours per day as it would to another using 100 lamps for 1 hour per day. He must recognise that in the latter case nearly 10 times the capital would have to be laid down in plant and copper than in the former; evidently, therefore, contrary to Mr. Lewis's assertion, the cost of production depends much *more on the consumer* than the producer.

Dealing next with the equity and expediency of differential charges from a Joint Stock Company's point of view, Mr. Lewis urges that it is not fair to the consumer to charge him otherwise than on an uniform basis, although we frequently hear of water companies in this country being allowed to charge for the supply, either by a fixed rental or by meter at *their* option only. In my opinion it is not any more to the advantage of the company to supply on a differential basis than it is to the profitable consumer, who, it must be remembered, is the only class of consumer the company ought to be called upon to supply, as the losses on unprofitable consumers have to be borne by the profitable ones, and not by the company's shareholders, who will naturally raise their tariff to prevent such losses affecting them.

If the company are to be compelled to supply unprofitable as well as profitable consumers, and also are to charge them at the same rate, it follows that that rate must be much higher than would be necessary were the unprofitable ones excluded. All should be made to pay a varying rate, sufficiently high to yield an *uniform* rate of profit on the cost of supplying each individually; this is the only system by which *all* classes can be equitably supplied, either by a company or municipality.

Making one customer pay the loss on another obviously means keeping up the rate of charge to the former unnecessarily, and further means encouraging the unprofitable and discouraging the profit yielding ones, which policy must both restrict the profit earning capacity of the company and tend to restrict the use of the supply by the profit earning consumers, whereas, on an equitable sliding scale, the consumer pays at a rate in direct proportion to the cost of supplying him, which is a benefit no uniform price system can possibly give him.

In conclusion, it seems to me that the only interested party benefited by Mr. Lewis's strong advocacy is not the rapacious supply company, but the fortunate consumer whose short use of the plant prevents him being charged at a remunerative rate, and thus permits of his being able to get his electricity at less than it costs the company to supply him.

Arthur Wright.

The Langdon-Davies Motor.

Referring to my comparison of a tri-phase motor with a Langdon-Davies motor of the same nominal output, I certainly should have drawn attention to the respective frequencies in the tests.

I may remind Mr. Whitcher that there is considerable magnetic leakage in an induction motor. This has to be allowed for, and Mr. Davies's researches seem to prove that the best way of producing a uniform useful flux through the rotor is by winding the stator in such a fashion as to give a uniform field when the rotor is absent.

The torque varies as the square of induced E.M.F., so that any variation in the strength of the rotary field will cause at least double the variation in the torque. For work in which steadiness of the starting torque is unimportant there is no particular advantage in having a rotating field of constant strength. As a matter of fact many of the Langdon-Davies motors are wound with the starting coil at right angles to the running coil.

I have given considerable attention to polyphase problems, but, although Mr. Davies's way of producing a constant field rotating with constant angular velocity is mathematically obvious, I am not aware that anybody has even thought of its practical application before.

The Writer of the Article.

Electricity Meters.

Your issue of July 3rd, contains a letter from the General Electric Company, Limited, on the subject of electricity meters. A careful reading between the lines of this, discloses the fact that the writer has some slight prejudice in favour of the clock meter, as against the mercury and motor types, and, moreover, that of clock meters the Aron is THE clock meter.

In support of this opinion as to the superiority of the former over the latter, he adduces the number of meters in use on the Continent, an example which mere English station engineers should certainly lay to heart. He also informs us that the Aron was an excellent meter in the early days of electric lighting.

We cannot answer for the central station engineers, whose opinions would be of at least equal importance with that of either manufacturer or agent, but we are glad to be able to assent to his opinion about the early days, the golden days before the appearence of the bad mercury meter.

Were we to follow in the footsteps of the General Electric Company, we might say something in favour of the Chamberlain & Hookham meter, which we represent; modesty, however, forbids such a course.

Venner & Sillar.

LEGAL.

An Electrical Engineer's Slander Action.

Before Mr. Justice Kennedy and a special jury in the Queen's Bench Division of the High Court of Justice, on Thursday, the action of Medhurst *v.* Kyffin came on for hearing. The action was one for slander, plaintiff being an electrical engineer of Victoria Street, and defendant a draper and clothier of Hackney Road, and a member of the Hackney Vestry. Sir Edward Clarke, Q.C., M.P., and Mr. Charles Mathews were for the plaintiff, and Mr. Cock, Q.C., Mr. W. H. Eldridge, and Mr. G. Blaiklock for defendant.

Sir Edward Clarke, in opening the case, said plaintiff was an electrical engineer and a member of the Institution of Electrical Engineers, holding various appointments in London and in the provinces. In the early part of July, 1895, he was invited to become consulting electrical engineer for the parish of Hackney, the Vestry of which had determined to adopt electric lighting. An Electric Lighting Committee of the Vestry was appointed, of which a Mr. Sheehan was chairman, and defendant was a member of it. The Committee was instructed to visit various places and to report on the various systems of electric lighting in use, and they went to Portsmouth amongst other towns. During that visit defendant was accompanied by his son, a youth of 17 or 18, who was desirous of becoming an electrical engineer, and plaintiff was asked to take him into his office, but plaintiff, on the following day, said he must decline to do so as it might be considered improper considering the position he held. Defendant appeared to be annoyed at the refusal, and on August 21st told a Mr. Raper, a member of the Vestry, there were many rumours and scandals in connection with the Electric Lighting Committee, and that he had heard that Mr. Medhurst had given the chairman of the Committee £50. Mr. Raper repeated that statement to the plaintiff, who subsequently called on defendant with his uncle when defendant repeated the statement, and added that whilst at Portsmouth his elder son was told by Alderman Ellis that they must be very careful as to employing plaintiff in connection with the work, as he had heard some very damaging things about him. The defendant was pressed to give his informant as to the first statement, and, after some time, said it was a Mr. Pressland, another electrical engineer. The Vestry had considered the matter and had recorded their confidence in Mr. Sheehan, but as defendant had declined to withdraw what he had said as to Mr. Medhurst, or to apologise, plaintiff had no other course open to him

than to bring the present action. Plaintiff was called in support of counsel's opening statement, and said that he had told defendant that if he would give the name of his authority for circulating the rumours, and apologise, he would be satisfied. Defendant, however, had never expressed any regret.

Mr. Geo. Raper, boot manufacturer, Hackney, and another member of the Electric Lighting Committee of the Vestry, spoke to the words being used by defendant who said subsequently, "Medhurst will never be electrical engineer at Hackney, and Sheehan will never be chairman. There will be an Old Bailey job, after which it will be public property, and then I will follow him (Medhurst) wherever he goes."

Sir Edward Clarke having intimated that he did not consider it necessary to call Mr. Sheehan, Mr. Cock for the defendant said the question before the jury was one of great importance to public men, and he maintained that defendant had from beginning to end done no more than it was his bounden duty to do under all the circumstances. The occasion on which the words were used was a privileged one and it was the duty of Mr. Kyffin to make the observations he made under the circumstances. Unless the jury was satisfied that defendant was acting from some evil and vindictive motive he was entitled to their verdict. Defendant was then placed in the box and admitted having made the statement in question to Mr. Raper. He kept the name of his informant back because he believed in his *bonâ fides*, and that he would be able to get corroboration. He had no ill-feeling against Mr. Medhurst or Mr. Sheehan, and actually proposed the election of the latter as Chairman of the Electric Lighting Committee. He had not circulated the statement outside and had only made it to Mr. Raper. Cross-examined: He had never been in favour of Pressland having the work. He had no opinion to express on the alleged slander at present, but he admitted that he had in the Vestry repudiated the charge against the chairman of having received £50 from Mr. Medhurst. By implication, perhaps, the same remarks might have, he thought, have been supposed to apply to Mr. Medhurst. He admitted having said that Medhurst would never become electrical engineer for Hackney as he did not believe that the vestrymen would appoint anyone who brought an action against one of their body. Mr. Medhurst's pay, if the whole scheme was carried out would be about £4,000, but the work had not yet been begun, it had been referred back to the committee. Mr. Cock having urged to the jury that his client had only acted in accordance with his duty as a public man, and without any malice or ill-feeling towards plaintiff,

Sir Edward Clarke said he heard with amazement the statement made by the defendant in the box when he was given an opportunity of withdrawing the slander, that he would express no opinion upon it, and in face of that state of affairs he asked the jury to give his client such damages as would compensate him for the injury which his reputation had sustained.

The hearing of the action was concluded on Friday.

His Lordship, before proceeding to sum up the evidence, informed the jury that he ruled, as a matter of law, that all the occasions on which the defendant uttered the alleged slanderous words were privileged, and therefore they ought to find for the defendant, unless they believed that he had been actuated by express malice. They must look at all the circumstances and consider the probability of malicious motives and words, and of a desire to injure, which was inconsistent with an honest and *bonâ fide* attempt to discharge a public duty. If they found there was express malice then they must award the plaintiff such damages as were consistent with his position and the injury which his reputation had sustained.

The jury, after a short retirement, found a verdict for the plaintiff and awarded him £400 damages.

BUSINESS NOTICES, &c.

Amendment of Specification.—From our "Official Notices" it will be seen that Mr. J. Brockie has applied for leave to amend the specification of Patent No. 23,825 of 1894, for "Improvements in electric arc lamps."

Bankruptcy Proceedings.—His Honour, Judge Bagshawe, Q.C., sitting at the Brentford County Court a few days ago, heard the adjourned application of Ronald A. Scott for his discharge in bankruptcy. Judgment was entered for the petitioning creditors for £500 which Mr. Scott said he would pay out of money earned in excess of £350 per annum. After some further discussion His Honour entered judgment as above stated and granted the discharge, but added an order that Mr. Scott was to file and confirm by affidavit, every half-year in January and July, an account of his earnings for the preceding six months; and to furnish a copy of this to the Official Receiver. Mr. Clawson said he had hoped to have called witnesses to clear Mr. Scott's character of any slur, and show that the whole troubles resulted from the formation of the company. He had, however, not had an opportunity of doing so, and he supposed he could not ask His Honour to say definitely that his client was not to blame. His Honour: I think I may fairly say this—I have no minute recollection of the details, but my general impression is that in all that has transpired nothing whatever has come up, which is inconsistent with Mr. Scott's leading an honourable career, or anything which should prevent anyone from having compunction about dealing with him. Undoubtedly Mr. Scott made serious errors of judgment, but that is not in the least a reason why he should not henceforth flourish as a successful and honourable engineer.

Electrical Wares Exported.

Week Ending July 7th, 1896.	£	s.
Amsterdam	130	0
Auckland	50	0
Barcelona. Teleg. cable	33	0
Bilbao	20	0
Bombay...	283	0
Boston	61	0
Boulogne	41	0
Boca. Teleg. material	241	0
Bremen	39	0
Brussels...	972	0
Buenos Ayres	500	0
Cape Town	87	0
" " Teleg. mtl.	9,482	0
Calcutta	50	0
Colombo	26	0
Copenhagen. Teleg. mtl.	24	0
Durban	24	0
East London	2,142	0
Flushing	71	0
Gibraltar. Teleg. mtl.	49	0
Gothenburg. Teleg. mtl.	851	0
Hong Kong. Telep. mtl.	19	0
King George's Sound ...	38	0
Launceston	649	0
Melbourne	152	0
" Teleg. mtl.	568	0
New York	41	0
Ostend	52	0
Passages	1,775	0
Paysandu. Teleg. mtl.	800	0
Penang	280	0
Port Elizabeth... ...	144	0
Rotterdam	421	0
St. John, N.B.	15	0
Santander	6	0
Singapore	49	0
" Teleg. mtl.	365	0
Suakim. Teleg. mtl. ...	14	0
Sydney	922	0
Tientsin...	48	0
Wellington	99	0
Yokohama	152	0
Total	£21,785	0

Week Ending July 7th, 1895.	£	s.
Alexandria	16	0
Amsterdam	50	0
Algoa Bay	132	0
Bordeaux	70	0
Brisbane...	50	0
Buenos Ayres	165	0
" " Teleg. mtl.	2,237	0
Calcutta	1,288	0
Cape Town	193	0
Colombo	25	0
Copenhagen. Teleg. cable	1,071	0
East London	1,223	0
Gandia	823	0
" Cable	215	0
Madras	29	0
Melbourne	86	0
Monte Video	45	0
Piræus. Teleg. mtl. ...	31	0
Port Natal	22	0
" " Teleph. mtl.	15	0
Shanghai. Teleg. mtl.	231	0
Singapore. Teleg. mtl.	42	0
Stockholm	276	0
Sydney	808	0
Wellington	126	0
Yokohama	142	0
Total	£9,411	0

Foreign Goods Transhipped.

		£	s.
Brisbane.	Electl. mtl.	279	0
Rotterdam	... ...	31	0
Shanghai.	Teleg. mtl.	51	0
	Total	£361	0

		£	s.
Boulogne.	Electric mtl.	43	0

Dissolution of Partnership.—Messrs. Wm. Kilburn and Wm. Sykes, hitherto trading as Wm. Kilburn and Sykes, at 21, Newgate Street, Bishop Auckland, as "ironmongers, gas fitters, locksmiths, hot and cold water engineers, plumbers, electricians, &c.," have dissolved partnership by mutual consent. All debts will be attended to by Wm. Kilburn.

Catalogue.—Mr. F. C. Allsop has published a catalogue of electrical supplies, including lighting, bell and telephone and general fittings and accessories. Amateurs, as well as other electrical men, will doubtless find it of service.

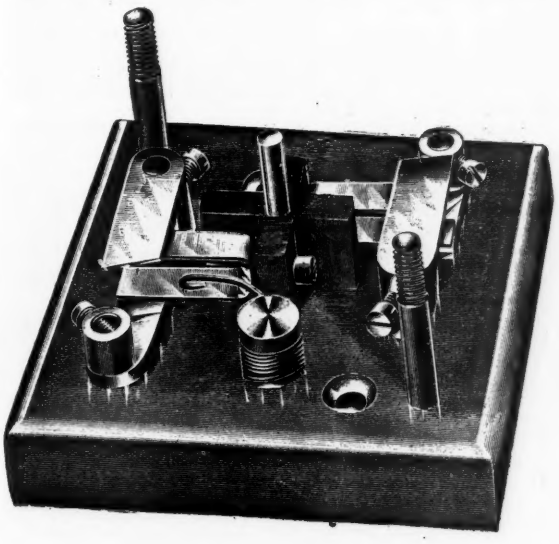
Crompton & Co., Limited.—We understand that Messrs. Crompton have secured a convenient site for their new premises at Chelmsford. The site, which is about half-a-mile from the railway station, is nine acres in extent.

Guatemala Exhibition, 1897.—The Department of Science and Art has received, through the Foreign Office, a translation of a note from the Guatemalan Minister in Paris, enclosing a copy of the regulations issued for the above exhibition. The exhibition will be opened on March 15th, 1897, and will last for six months.

"The London Manual."—This publication for 1896-7, which is published from the office of *London*, will be found of great service by those requiring general information concerning the London governing authorities, such as the London County Council, the City Corporation, the Commission of Sewers, and the London School Board, also water companies, boards of guardians, &c. The various sections dealing with these and other matters are interesting as well as useful, but we have no hesitation in saying that the chapter devoted to the "Electric Lighting Undertakings" of London is very inaccurate, the names of companies, officials, and the last dividends paid being in need of careful revision. For instance the last dividend of the St. James's and Pall Mall Electric Light Company is set down as ¾ per cent. instead of 7½.

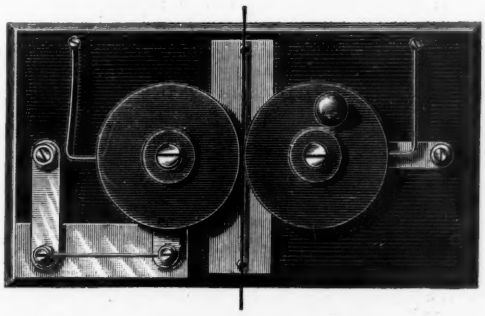
To Stockholm.—Messrs. J. C. Lyell & Co., electrical engineers, &c., of 55, Victoria Street, S.W., have sent us a small book with views of Stockholm, which may prove of interest at this holiday season. We understand they will be pleased to forward a copy free of charge to any electrical engineer who would care to have one.

The "Triumph" Switch.—Messrs. Heaton & Co., of Manchester, send us a sample of their patent double-pole switch, the "Triumph," for which they are having a steady demand in sizes from 10 to 100 amperes. We find upon examination that in that most important detail, mechanical construction, the switch is reliable, while the arrangement of the contacts is such as to render accidental short-circuiting apparently impossible. The "make" and "break" are

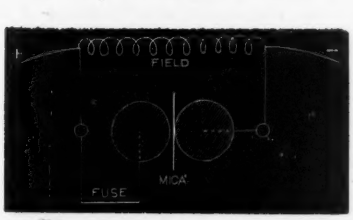


instantaneous, and we should say that the contacts of H.C. metal allow ample margin for variations of current. The illustration shows the means adopted to secure the perfect insulation of the poles. The covers are of china, but for rough work they are made with asbestos-lined cast-iron covers.

Johnson & Steele Automatic Potential Arrester.—This instrument is the invention of W. Claude Johnson and L. J. Steele, and is manufactured by Messrs. Johnson & Phillips. It is employed for automatically arresting the rise of potential such as is induced on breaking the field-magnet circuit of a dynamo or other circuit of high self-induction; the electromotive force in such a case



being, as is well known, sometimes sufficiently high to break down the insulation of the coils or of conductors and instruments connected to the circuit. The device is connected as a shunt to the inductive



Connections for Potential Arrester.

circuit, and consists, as is seen in the accompanying illustration, of two carbon discs mounted side by side on a slate base. These discs are pressed towards each other by springs, but between them is interposed a strip of mica of suitably adjusted thickness, which, not being so wide as the faces of the discs, leaves a small air space between them. A safety fuse is provided which, in case of a permanent circuit being established between the discs, will give way and thus prevent short-circuiting the field. The discs can be turned on their axes so as to present towards each other fresh portions of their peripheries, which are cleaned by metal scrapers that bear against them. If the field circuit of a dynamo is broken accidentally or otherwise, the difference of potential at its terminals will rise to an amount sufficient to produce a spark between the two discs, and this spark will last until the field has gradually died down. In some cases, especially when breaking the field circuit of large multipolar machines or alternators, the spark is seen to last as long as 20 to 30 seconds. Messrs. Johnson & Phillips have supplied a large number of these instruments.

Large Turbine Contract.—We learn that the Stilwell-Bierce and Smith-Vaile Company have secured the largest contract ever given for a turbine installation. This contract comprises the development of the water-power on the Richelieu river which forms the outlet of Lake Champlain. The development will amount to about 21,000 H.P., which is to be transmitted electrically into Montreal, some nine miles distant, where it will be sold for various purposes. The contract price for the hydraulic installation is $550,000 (£124,000). This is in addition to the Lachine Rapids installation to which we have already briefly referred. These are the "Victor" turbines, for which Mr. F. Nell, of London, is the foreign representative.

London Office.—Messrs. W. H. Bailey & Co., Limited, of Salford, state that they have recently opened a London office and showrooms at 7, Victoria Embankment, Blackfriars, E.C.

Outing.—On Saturday last the men employed by the Brush Company on their Wandsworth contract, had an excursion to Bognor. Dinner was served at the Beach Hotel.

Telegraphic Addresses.—No. 2 supplement for 1896 of "Sell's Directory of Registered Telegraphic Addresses," has just been issued by Henry Sell.

ELECTRIC LIGHTING NOTES.

Asylum Lighting.—It is proposed to spend £3,500 upon fitting up the Somerset and Bath Asylum for electric lighting.

Bath.—Mr. Brydon is to draw up a specification for wiring the new pump room of the Baths Committee. Tenders for the work will be required shortly.

Brighton.—The Local Government Board has sanctioned the borrowing of £8,800 for public, and £27,100 for other electric lighting.

Bristol.—The Electric Lighting Committee has decided to make a short extension to Burlington Road, Redland. The Motive Power Sub-committee has received instructions to draw up a modified scale of charges for the supply of electricity for motive power, and the engineer is to report whether all dangerous places in the central and sub-stations are properly protected, and are as reasonably safe as he could desire, with the view of avoiding the risks of accident. Instructions were given to the secretary to advertise for all further supplies of coal needed for the works.

Calcutta.—*Indian Engineering* says: "The Municipality having permitted Messrs. Kilburn & Co. and Messrs. Martin & Co. to proceed with their applications for a Government license, it now remains with the Local Government to settle their claims. The former contemplate a large scheme combining electric lighting with the working of the tramway by electricity throughout Calcutta; the latter propose a more modest plan of lighting the business portion of the town only."

Chamounix.—The Municipal Council of Chamounix has just voted a sum of 100,000 francs for electric lighting. It is expected that this part of Mont Blanc, familiar to tourists, will be electrically lighted by next summer.

Chesterton (Staffs).—At the Parish Council monthly meeting, Mr. Arthur E. Andrews, electrical engineer to the Midland Coal, Coke, and Iron Company, Limited, attended, and gave information as to the electrical plant that would be required for lighting the streets of Chesterton with electric light, besides allowing for 180 private. Mr. Andrews was thanked for his attendance and information.

Colchester.—Someone is to be appointed to canvass the district and ascertain what supply of current is likely to be required by consumers.

Crewe.—A sub-committee recently made several recommendations regarding the new Isolation Hospital, the most important of which was to supply a boiler and furnaces of sufficient dimensions to supply steam for the laundry and the disinfector, and to drive an engine and dynamo for electric lighting purposes, the furnaces to be of a type constructed to burn unscreened ashpit refuse. The boiler and furnaces, and the electric lighting plant and installation, were estimated to cost about £800. The report was adopted by the Town Council.

Darwen.—Inquiries are being made on behalf of the Corporation *re* electric lighting, and it is proposed to appoint Mr. E. M. Lacey, electrical engineer, to report.

Dublin.—The North Dublin Union is asking the Corporation upon what terms they will supply electricity for the workhouse buildings.

East Grinstead.—The East Grinstead Electric Lighting Company, Limited, has been formed with a capital of £15,000 for lighting the district by electricity. The company met last week, when Messrs C. M. Wilson, W. H. Hills, and A. A. Winser were appointed directors, and Mr. Elphinstone Dayrell secretary. Messrs. Owen Lucas and Pyke are the electrical engineers. The company is already negotiating for the purchase of a site on which to place their works, and in the course of a short time, should the responses to a preliminary circular justify the step, a prospectus will be issued to the public, and it is hoped that before November arrives, when the Board of Trade order is to be applied for, a sufficient amount of share capital will have been guaranteed to authorise the promoters in launching the undertaking. The District Council is considering the matter, and has referred it to a committee for consideration.

Greenwich.—The Blackheath and Greenwich Electric Light Company has given notice to the Board of Works that it intends applying for a provisional order. A committee is considering the matter.

Hammersmith.—The Vestry has confirmed the decision of the Electric Light Committee to accept certain tenders (which have already been noted in our columns) for the electric lighting plant and works.

Hampstead.—The electrical engineer is to prepare a specification and estimate for the lighting of the branch library at Antrim Street by electricity, and to report on the expense of wiring and lighting the news and reading rooms at the Kilburn Branch Library. The Vestry has decided, upon the recommendation of the Electric Light Committee, with reference to the letters from the Westinghouse Electric Company, Limited, as to the system of supply used by the Vestry coming within the claims of the Hopkinson patent, and as to granting a license, to deny any liability in the matter of such patent.

Helensburgh.—The electric lighting scheme has been abandoned because of its great cost.

Hull.—The question of the electric lighting extensions comes up again at the next Council meeting.

Islington.—The County of London and Provincial Brush Electric Lighting Company has notified the Vestry that it is about to apply for power to supply electric energy within a portion of Islington. A letter of explanation pointed out that the company had no intention of competing with the Vestry in the supply of electric energy, but needed to pass its mains through a portion of Islington in order that two areas in which it had mains might be connected. The letter stands referred to the Electric Lighting Committee.

Leeds.—The installation of the Yorkshire House-to-House Electricity Supply Company, at Leeds, has now on its mains about 37,000 incandescent lamps and about 100 arc lamps, the latter being in warehouses, &c., no street lighting having yet been done in this direction. During the 12 months passed, about 13,000 incandescent lamps have been added, and the company is preparing to lay down additional plant to meet the increased requirements. It is intended to add two Ferranti dynamos driven by Belliss engines direct coupled, this arrangement being adopted in preference to the existing rope-driven machines on account of space. Four new Lancashire boilers will be installed, each 30 feet × 8 feet 6 inches, these being each slightly larger than the six at present in use. The whole system is one of 2,000 volts alternating, and in connection with the same there are about 350 Lowrie-Hall transformers; it is intended to add a 200-volt low tension system. Plenty of ground space is available for extension, there being at present floor room for 4,000 additional horse-power. It is a noteworthy fact that several large private installations have discontinued supplying their own current, and have been connected on to the company's mains. The latter extend to a distance of 3½ miles from the supply station. It may be added that the price per unit continues as heretofore at 6d., the price of gas being 2s. 3d. per 1,000 cubic feet. No motors are worked off the system, but it may be mentioned that a motor is used in the station to work the Bennis mechanical stokers. The alternators at present in use are three 200-kw. and two 100-kw.

Lewisham.—We understand that the Blackheath and Greenwich District Electric Light Company intends applying for a provisional order for lighting the district of Lewisham, and has given notice to the District Board to that effect.

Manchester.—A Local Government Board inquiry regarding the £250,000 loan required for gas, and £100,000 for electric light extensions, was held on Thursday, July 2nd.

Messrs. J. Lomax Kendal & Co., have secured the contract for lighting by electricity from the Corporation mains, the Church of St. Ann and St. Mary, Manchester, which is one of the oldest churches in the city. The fittings are to be of a substantial and artistic design finished in chocolate and gold. Amongst other important contracts this firm have in hand is the country residence of J. H. White, Esq., at Disley, where they are fitting up an installation consisting of oil engine, dynamo, accumulators, &c., in accordance with specification drawn up by H. C. Crews, Esq., A.I.E.E. They are devoting considerable attention to a patent watertight and acid proof suspension fitting for bleach works, print works, dye houses, chemical works, &c., where it is considered there is room for improvement as against the rigid fittings. This to be placed upon the market shortly.

Merthyr Tydfil.—A petition has been deposited in the Private Bill Office of the House of Lords on behalf of the Merthyr Tydfil Gas Company, praying to be heard by counsel in Committee against the Electric Lighting Provisional Orders (No. 7) Bill (Merthyr Tydfil Order).

Mile End.—We make the following extracts from the report of the Special Committee on Electric Lighting:—"Your Committee visited Hampstead, St. Pancras, Brighton, Southampton, and Portsmouth electric lighting stations. At St. Pancras your Committee were much assisted by the resident engineer, who informed them that special apparatus had been laid down for the purpose of producing steam from the burning of house refuse, but the same had not proved successful. Practically, the whole of the work had to be accomplished by the use of coal." Here follows full particulars of the other stations visited:—"After fully considering the information obtained, your Committee are of opinion that it is advisable to light the hamlet by electricity, and accordingly recommend: That application be made to the Board of Trade for a provisional order to enable the Vestry to do this."

Morley.—At the last Council meeting, the Town Clerk reported that no objections had been deposited to the Corporation's application for the granting of a license for carrying out an electric lighting scheme. Compliance with the Electric Lighting Act and the proving of plans having been completed, everything was now ready for the scheme being proceeded with.

Oldham.—The Council has agreed to apply for the £10,000 loan, to which we referred last week, for electric lighting purposes.

Peterborough.—The Local Government Board has replied to the Town Council, that as the result of the recently held inquiry, it is not prepared to sanction the borrowing of £20,000 for electric lighting, as the opposition was considerable, and as the Council would seriously diminish resources which should be available for other purposes which the Board enumerate. It is said that steps are being taken to form a company.

Poplar.—The Board of Works has instructed the Dust Destructor Committee to report on electric lighting.

Portsmouth.—The Electric Light Committee is to send a deputation to towns in the Midlands to consult the engineers of electric light works where the types of engines are at work which the Committee contemplate purchasing. This is to obtain the information for the guidance of the Committee.

Richmond.—A Committee of the Council will consider the advisability of purchasing the Castle Mill, respecting which there was an application for electric lighting. It was felt that the town should do its own electric lighting if such is introduced at all.

Salford.—At the last Council meeting it was stated that the Gas Committee had no intention of lighting the principal thoroughfares of the borough with electricity, unless shopkeepers came forward prepared to pay for it.

Salisbury.—After communicating with the Salisbury Electric Light and Supply Company, the Board of Trade has agreed to defer consideration of the question of revocation of their 1895 electric lighting order for three months from June 1st.

South Africa.—The following notes regarding orders for electric lighting and other plant are given by the *British and South African Export Gazette*:—The electric lighting installation of the new Congregational Church at the corner of Bree and End Streets, Johannesburg, which consists of a series of arc lamps, of 500 candle-power, was carried out by Mr. J. Hubert Davies.—The general manager of the Natal Railways is considering the question of the better supply of the electric light in railway carriages.—The contract price for the installation of the electric plant into the State Printing Office, Pretoria, which was secured by Messrs. Delfos & Co., amounted to £6,203.—The Durban Town Council have, on the recommendation of Mr. W. H. Preece, decided to adopt concentric low tension mains in place of ordinary insulated mains in their electric lighting scheme. The indent is being executed by the Electric Construction Company.—The Maritsburg Town Council has practically decided upon obtaining an electric lighting installation.—It is almost certain that electricity will be adopted in the lighting of Uitenhage, Cape Colony.—If the proposed amalgamation is carried through, a large electrical installation will be ordered for the No. 2 shaft on the Nigel Deep mine, which will serve both the above mine and the Nigel Central, and do the pumping and other work on both.—A Woodhouse & Rawson 2-pole dynamo of 110 amperes, running at a pressure of 110 volts, and a speed of 880 revolutions per minute, has been fitted up in Messrs. Thomas Begbie & Co.'s new foundry in Johannesburg. This dynamo supplies all the lighting power for the new works, and transmits power to a little E.C.C. motor of 90 amperes 110 volts. The lighting power in these works will consist of 800 lamps of 16 C.P., and five central lamps for the foundry of 500 C.P. each.—The machine tools on the Chimes West property are, we believe, to be driven by an electric motor.—The kiosks to be erected in the streets of Cape Town for the sale of newspapers, will be fitted with the electric light.

South Shields.—A question was asked the other day by a Councillor as to the progress and prospects of the electric lighting scheme, which he was told would likely amount to £40,000. The reply was to the effect that the estimate of £27,000 or £28,000 was not likely to be exceeded. In a few days the arc lamps will be in position, and it is believed that the whole scheme will be a great success.

Tonbridge.—At the last Council meeting the Guildford Electric Supply Company, Limited, notified that it was their intention to apply for a provisional order to supply electricity in the Council's district. The Clerk explained that the same company gave a similar notice every year. The matter was referred to the Highways Committee.

Torquay.—A public meeting of ratepayers passed a resolution last Friday, protesting against the Council's electric lighting scheme, and appointed a deputation to bring the resolution before the Local Government Board at the inquiry to-day.

Wakefield.—A Committee of the West Riding County Council have had under consideration the question of electric light for the new county offices at Wakefield, and have had a special report prepared by Mr. Sydney à Court, London, upon the subject. The Wakefield Corporation will shortly be in a position to supply the electric light, but Mr. à Court is of opinion that very considerable economy, besides other advantages, would be secured by putting down separate plant. The Committee will recommend the Council to do this.

Watford.—The Council is to apply for a provisional order.

Wimbledon.—The County of London and Brush Provincial Electric Lighting Company having given notice of intention to apply for a provisional order, the Council has been informed that the company cannot apply for powers until next July (1897), and it is probable that the Council will then make application for an order for itself.

York.—The Mayor has received from various bodies copies of resolutions passed in opposition to the electric light scheme. These have been entered upon the minutes, and will be considered when the Electric Light Committee has reported upon the tenders.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Birmingham.—The City Council has decided to accept the offer of Messrs. Mackenzie and Ross, of Montreal, to take a new lease for 21 years of the system of tramways at present worked by the Central Tramway Company, whose rights the syndicate have provisionally agreed to acquire. We have already referred to this matter.

Cheltenham.—At a meeting of the Town Council on Monday afternoon, a proposal came up for the construction of an electrical tramway from Leckhampton Road through the town to Cleeve Hill, a rapidly rising district, and the scene of the golf links. The proposal was made on behalf of Mr. Thomas Nevins, of Nevins Park, Gorey, Ireland. A route was indicated, to which the Highway Committee did not agree, and suggested another, but this found little favour with the Council generally, who were of opinion that the line would be for the advantage of the town, and should take a popular route. It was proposed that the Corporation should supply the electric power from their own works by means of overhead wires, which, it was stated, would be low tension. The discussion resulted in the question of route being referred back to committee, and the Town Clerk was instructed to prepare a provisional agreement as between the Corporation and the promoters.

Dublin.—On June 30th, the Dalkey Electric Tramway undertaking was handed over to the Dublin United Tramways Company pursuant to the contract of sale. At midnight Mr. Wm. Anderson attended to receive possession of the line, which will in future be worked by the United Tramways Company pending the formation of the joint board of management. Two meetings have to be held to confirm the sale, one by the Dublin Southern District Company, the other by the Dublin United Company. The date for the former is understood to be the 14th inst.; for the latter the 21st inst. Pending these formal steps Dalkey line is being worked for the benefit of the Dublin United Company under a certain arrangement. The traffic over the line continues to be very great, taxing to the utmost the special tramcar service from Abbey Street to Haddington Road.

Experiences of a Motorman.—A new man, who took the place of a Milwaukee striker, recently described his first two days' experiences in the following graphic manner:—"Fred Phillips came with me, and I got him as my conductor. We have been through the fire now for two days. I got all my windows broken both days. Bricks and stones rained like hailstones about our heads. Their cries are deafening. We are called all the names, curses and swears you ever heard in your life, but we care not. I am here, and shall hold my motor or die. They cannot scare me. Two big brewery fellows, at 12 to-day, as I was turning up Walnut Street, there were hundreds there throwing stones, but these two jumped on my car to pull me off. One the policeman cracked on the head with his club, the other I kicked in the head. Both went rolling in the street. At the same time I gave my car the loop, and she went flying through them 20 miles an hour. The air was blue with their shouts. We are operating the roads in spite of them. I made eight round trips to-day, but yesterday I lost my way, as neither I nor Fred Phillips, my conductor, knew one street from another, but we got back after travelling all over the town. We got on lines where there has not been a car run since the strike started, and you can guess what a job we had to get through. There was everything imaginable thrown on the tracks to block us, but we fought our way foot by foot, and got back without a scratch. Fred stuck to me like glue, and when any of them goes for me he goes for them, and when they go for him I go for them with my controller handle. They have fought us, they have coaxed us to desert our cars, but all in vain. We came there to work, and we are stayers or die. Well, we are in the war; I expect you will laugh when you read this; two Welsh boys together on the one car. Fred is a six-footer and an ex-sergeant of the British army. We have both seen service for the Queen, fighting savages. Now we are fighting white savages in Milwaukee."—*Street Railway Review*, Chicago.

Glasgow.—A meeting of the sub-committee on mechanical traction in connection with the Tramway Committee of Glasgow Corporation, was held on 30th ult. The reports by the two deputations which visited Hamburg were fully considered, and it was unanimously agreed to recommend the Tramway Committee to fit up at the earliest possible date the overhead system of electric traction for tramcars along the route from Kelvinside to Dennistoun.

Rapid Transit in New York.—Our American contemporaries are agreed that the cause of rapid transit makes very little progress. The *Electrical Engineer* says:—"The plans of the Rapid Transit Commission, including the part underground and part viaduct road from the Battery to Harlem, and operated by electricity, were generally considered an established undertaking until last month, when the Supreme Court of this State vetoed the proposition on purely economic grounds. Although $50,000,000 was the estimated cost of this undertaking, it is not improbable that before such a road could be completed this amount might be considerably exceeded, and as this sum is greater than can be readily procured from private capital for an investment of this nature, New York City's only present alternative is to secure as great extensions and improvements of existing systems as possible. . . . . The elevated roads in New York are ideal roads for the employment of electric propulsion, and if this were to be adopted by them, in addition to the west side and crosstown extensions which have been proposed, it would do considerable towards relieving the excessive pressure of travel on these roads mornings and evenings. . . . . The subject of electric propulsion is not in an experimental state, and several similar roads in this country are successfully operated by electricity, so the officers of the Manhattan system could easily assure themselves of the better service and greater economy of electricity if they desired to investigate the subject. Their policy, however, seems to be to wait until the change is imperatively demanded. The surface roads of New York cannot be said to be making much better progress in the improvement of their facilities than the elevated roads have done, although a number of new methods of propulsion have been tried on various lines. The cable on Broadway, after a trial of some three years, is reported to be found wanting in several respects, and it seems pretty certain that but little more extension of this system will be made. The storage battery has been given a very limited trial on other lines, but without definite results. Three or four styles of conduit roads have been installed in different sections of the city, and some objections have been raised against the Lenox Avenue system, which is the most extensive open conduit system tested in this city. The verdict on the other conduit lines remains to be found. In the meanwhile a step backward is to be taken this summer, we understand, on the Madison Avenue line, which is about to try compressed air. The superiority of electric propulsion to compressed air, both as to efficiency and economy, is so thoroughly understood among engineers, that it scarcely seems probable that the Metropolitan Company seriously considers compressed air as a commercial possibility."

The *Electrical World*, on the same subject, says that the recent decision of the Appellate Division of the Supreme Court leaves the situation practically in the control of the Elevated Railway Corporation, and it is now to this concern that New Yorkers must look for better transit facilities. "The problem which presents itself differs but little from that obtaining in other cities, although the course of travel is in but two directions. Owing to the comparatively large number of short trains, the load throughout the system is uniformly distributed, which presents a condition most favourably met by electric traction, and it is safe to say that no other mode of propulsion will be adopted. Several companies now stand ready to sign a contract for the entire equipment, which is sufficient evidence, if any were wanting, that no doubt exists as to the practical utility of electricity to the conditions presented. No better opportunity could be offered for the application of polyphase currents to electric traction, and if the conservatism of the Manhattan officials ever relaxes sufficiently to allow of a consideration of a change in motive power, it is not unlikely that polyphase currents and the induction motor will receive due attention."

South Africa.—The *British and South African Export Gazette* understands that the Johannesburg Tramway Company proposes to adopt electricity as the motive power for its conveyances, instead of horses and mules.—We learn that the electric tramway plant for Port Elizabeth will be similar to the Cape Town plant, with the exception of the engines, which will be of an English type, and the boilers of Babcock & Wilcox pattern. The generators will be belt driven, and supplied by the General Electric Company (Edison and Thomson-Houston systems), 180, Sumner Street, Boston, Mass.—An alternate current electrical transmission plant will be ordered at an early date for No. 1 pumping station on the George Goch mine.—The permanent way for the new Cape Town electric tramway, consisting of 85-lb. girder rails, was supplied by Messrs. Dick Kerr & Co. The cars were built by the J. G. Brill Company, of Philadelphia. They are mounted on non-pivotal motor trucks, and are equipped with G.E. 800 motors.

Spain.—The Tramways Company at Seville is considering the question of adopting electric traction on its lines in that town.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (1869, Anglo)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Monte Alegre-Santarem ...	May 5th, 1896 ...	...
Bissao-Bolama	May 30th, 1896 ...	...
Cadiz-Teneriffe	June 7th, 1896 ...	...
Jamaica-Colon	June 10th, 1896 ...	July 3rd, 1896.
Landlines.		
Trans-Continental line beyond Mazol (Mashonaland)	March 12th, 1896 ...	...
Bolinao-Manila—telegrams are sent by post	March 19th, 1896 ...	...
Communication with Cartagena and Barranquilla, Columbia.	May 22nd, 1896 ...	June 17th, 1896.
	July 4th, 1896 ...	...
Siberian lines near Chabarowska	June 8th, 1896 ...	June 19th, 1896.
Siberian lines between Blagovestschensk and Ekaterino Nikolsk	July 3rd, 1896 ...	July 4th, 1896.
Siberian lines between Krasnovinsk and Kransk	July 7th, 1896 ...	...

New German Cable Company.—A new cable company has just been formed at Cologne, under the title of the Deutsche Seetelegraphen Gesellschaft (German Submarine Cable Company). The primary object of the company is to lay a cable between Germany and Spain, and eventually to extend it to the United States. The present share capital amounts to 3,560,000 marks.

South African Telegraphs.—We (the *British and South African Export Gazette*) are informed that, owing to the increase in the Transvaal telegraphic traffic, a large scheme of extension is about to be undertaken. The additions will include a wire from Pretoria to the border of the Cape Colony; two wires from Johannesburg to the border of the Cape Colony; one wire from Johannesburg to Volksrust; one wire from Johannesburg to Standerton; one from Pretoria to Standerton; one wire between Johannesburg and Heidelberg; and one from Johannesburg to Vereeniging.

The Telegraph in British Central Africa.—A *Times* correspondent in the Nyasaland Protectorate says:—"Major P. W. Forbes left Blantyre on May 9th with a party of seven white men and over 600 Atonga, whom he had engaged at Blantyre to take south of the Zambesi to complete that portion of the African trans-Continental telegraph line which still remains unlaid between Tete and Salisbury. The former contractor for this portion of the line was unable to complete his contract owing to scarcity of labour. Major Forbes hopes to get this work finished in three months. At the same time, the Blantyre to Zamba section is being pushed on, and communication between the two places is hoped to be established by the beginning of July this year." A despatch in yesterday's *Daily Telegraph* entertains grave doubts as to the safety of Major Forbes's company. It is thought the men have been cut up.

CONTRACTS OPEN AND CLOSED.

OPEN.

Battersea.—July 14th. The Vestry of St. Mary invites tenders for the supply and erection of boilers, engines, switchboards, accumulators, wiring and fittings, &c., &c., for lighting the Municipal Buildings and Town Hall electrically. Particulars from Robert Hammond, consulting engineer, Ormond House, Great Trinity Lane, E.C.

Bedford.—July 14th. The Urban Sanitary Authority invites tenders for the supply of steam coal to their pumping works, sewage pumping works, and the electricity works, for the year ending July 23rd, 1897. Particulars from Mr. Porter, Clerk, Town Hall.

Crewe.—July 14th. The Corporation wants schemes and tenders (*a*) for erection of a refuse furnace and boiler upon land adjoining the site of their isolation hospital; (*b*) supply and erection of an engine and dynamo, laying of electric lighting mains, and placing a complete electric lighting installation in the hospital buildings; (*c*) supply of accumulators, sufficient for the electric lighting installation. Particulars from Mr. Fredk. Cooke, town clerk, Municipal Offices, Earle Street, Crewe.

Ealing, W.—July 16th. Tenders are wanted by the District Council for the supply of coal to the electric lighting station, South Ealing; and coal and coke for another depot. Particulars from Mr. C. Jones, C.E., Surveyor to the Council.

Germany.—July 25th. Tenders are being invited for the supply and erection of the plant and fittings required for the electric lighting of the railway station at Bretten. Tenders to the General Direction of the Grosse-Badische Staats-Eisenbahnen, Carlsruhe.

Hull.—July 23rd. The Corporation wants tenders for the supply of an engine and dynamo for lighting the East District sewage pumping station. For further particulars see our "Official Notices."

Madras.—Nov. 11th. Lieut. Col. C. C. Rawson (in charge Consulting Architects' Division) invites tenders for the lighting by electricity of Government House, Madras, including the banqueting hall and the A.D.C.'s bungalow: also for the lighting of Government House, Guindy, including the Military Secretary's bungalow. Particulars to be obtained on application to the Consulting Architect to the Government of Madras, Chepauk, Madras.

Mexico.—August 31st. The Secretary of State for Foreign Affairs has received from the British Consul at Mexico, a pamphlet issued by the municipal council of that city, containing particulars as to tenders which are called for, for the public lighting of the city by electricity, and which must be put in by the last day of August, 1896. This pamphlet may be seen on application to the Commercial Department of the Foreign Office, between the hours 11-6.

Mexico.—August 31st. The Municipal Council of Mexico is inviting tenders for the concession for the electric lighting of the public streets during a period of eight years.

Portugal.—July 22nd. Tenders are invited for the supply of 10,000 porcelain insulators, with galvanised iron supports, and about 2½ tons of galvanised iron wire. Tenders to be sent to the Chef du Service des Magasins de la Compagnie Royale des Chemins de Fer Portugais, Santa Apolonia, Lisbon.

Wallasey.—July 16th. The District Council invites tenders for condensing apparatus and steam and exhaust pipes in connection with the electric lighting installation.

Wigan.—July 14th. The Gas and Electric Lighting Committee want tenders for gas coal and cannel. Particulars from Mr. J. Timmins, engineer.

CLOSED.

France.—The General Direction of the French Posts and Telegraphs, in Paris, has placed the contract for 125 tons of galvanised iron wire with the Société de Commentry-Fourchamboult, of Fourchamboult.

Hampstead.—The following building tenders were sent in for the erection of an extension to the central electric lighting station in Finchley Road:—

Chesham & Sons (accepted)	£7,499
Scharien	7,583
J. Simpson	7,551
R. Ballard	8,995
Yerbury & Sons	7,600

Norwich.—The tender of Messrs. Laurence Scott & Co. (£220), for wiring and fitting the Duke Street Higher Grade School for electric lighting, has been accepted by the School Board.

Paisley.—The tender of the Brush Company (£844) for wiring the George A. Clark Town Halls, has been accepted by the Town Council.

NOTES.

The Electrical Standardising, Testing and Training Institution.—As a result of the recent Scholarship examination, the following awards have been made by the Board of Control of this Institution:—To Mr. R. Pearson Russell, of the Royal Academy, Woolwich, a "Maxwell" Scholarship of 50 guineas tenable for two years; Mr. A. Thompson, of Dulwich College, an Exhibition of 35 guineas, tenable for two years; and to Mr. John Petrie, of Carlisle Grammar School, Mr. H. K. Rodwell, of Felsted School, and Mr. C. C. Hurford, of Epsom College, prizes of 20, 10, and 5 guineas respectively.

Chartered Institute of Patent Agents.—Members of the Chartered Institute of Patent Agents dined together at the Café Royal on Thursday evening last week to meet the Hon. John S. Seymour, the Commissioner of Patents of the United States. The guests included the Attorney General (Sir Richard Webster), the Comptroller-General of Patents (Sir H. Reader Lack), Mr. W. R. Bousfield, Q.C., M.P., Prof. Dewar, Mr. J. Fletcher Moulton, Q.C., and Mr. R. W. Wallace, Q.C. The chair was occupied by the President of the Institute (Mr. Lloyd Wise).

A Big Shipment.—The Westinghouse Electric and Manufacturing Company recently sent from their works at Brinton, Pa., one of the largest single shipments of electrical apparatus to Great Falls, Montana. The shipment filled eight freight cars, the freightage on the cargo amounting to $8,000. The machinery will be used by the Boston and Montana Consolidated Copper and Silver Mining Company in the refining of copper and silver, and it is said to be the largest machinery of its kind ever constructed for electrical refining purposes.

American Transmission Schemes.—We gather from an exchange that the Niagara Falls Power Company has ordered from the Westinghouse Company seven dynamos, with a capacity of 5,000 H.P. each, to be used exclusively for the Buffalo transmission. Contracts are also out for building a power house extension and wheel-pit for the dynamos. The officers announce that before summer closes power will be furnished to Buffalo. The same contemporary (the *Electrical Engineer* of New York) also says that the Lachine Rapids of the St. Lawrence are at last to be utilised. A fall of water is secured by means of a dam sufficient to develop at the low water season about 15,000 horse-power. This water-power is to be transformed into electricity. Upon the dam a power house will be built that will run its entire length, and show an unbroken interior of 1,000 feet in length. The basement of this will be occupied by Stilwell & Bierce water-wheels. The main floor will contain the dynamos, of which there will be 12, each of 1,000 horse-power, or 12,000 horse-power in all. They will generate current for transmission to Montreal, for use there in lighting the city, operating the street railroads, and for any and all other lighting and power purposes.

New Multiphase System.—Regarding the new multiphase system referred to in our issue of June 19th, Mr. Ludwig Gutmann writes to the New York *Electrical Engineer* as follows:—

With all due respect to Profs. Ferraris and Arno, allow me to say that my paper, read before the American Institute of Electrical Engineers, in 1894, contains the subject in a far broader way. No restriction is made therein to the number of phases of the transformed currents, nor to the frequency, but it is pointed out that from the single-phase source any kind of translating device may be supplied with its special current by the interposition of a phase splitting transformer, which in this particular case was a self-starting synchronous motor or motor generator. It was shown that from the single-phase alternating current dynamo continuous currents, as well as bi-phase and polyphased currents, might be produced and distributed to translating devices, requiring currents of such character. Possibly some claims are made on the transformer described, but no means for starting the short-circuited armature of the transformer is shown nor described (if I am not mistaken). It would seem as if the armature had to be started manually or by some auxiliary device.

When to Plan the Power House.—"We go about the building of power houses different from most people," remarked the manager of the electrical department for a U.S. syndicate which has electrically equipped many electric railway systems. "We contract for all the machinery first, and plan the power house afterward." His remarks call attention, says the *Street Railway Review*, to a mistake that is often made in designing power plants. Where land and buildings are cheap, it may be satisfactory to plan a building that will "surely be big enough to hold anything we will want to put in;" but such a method is almost sure to be wasteful of room, and if an attempt is made to design the building and its arrangements on a close margin before the exact form of machinery is known, the completed plant will be like a piece of cut-and-try patchwork. The proper order of things in building a power house is to first select the types of machinery, then buy it, then arrange it, and finally plan the house to cover it.

Early Experiments in Vacuum Tube Lighting.—From our New York namesake we learn that Mr. B. E. Greene, of Brooklyn, recently came into possession of an old book published at No. 60, Fleet Street, London, in the year 1787, which gives, among other things, an interesting account of some early experiments in vacuum tube lighting. The author of the book was one George Adams, "Mathematical Instrument Maker to His Majesty." The title of the publication was "An Essay on Electricity, Explaining the Theory and Practice of that Useful Science, and the Mode of Applying it to Medical Purposes. With an Essay on Magnetism. Corrected and Considerably Enlarged."

Leather Belting.—Some years ago perforated and flexible leather belting was all the rage, but now a new candidate for favour appears in the form of a grooved raw hide belting. The grooves or channels run lengthwise, and, according to *Electrical Engineering*, are formed by cementing separate strips of leather to the main body of the belt, thus avoiding impairment of the belt's strength were the grooves cut therein. The object of the grooves is to permit the free escape of air from between belt and pulley, thus enabling the belt to hug the pulley very closely, and insure slack running.

The Course of Bullets Changed by Electric Currents.—A curious phenomenon was recently observed by the Committee of the Swiss Federal Rifle Meeting at Winterthur. It was found, says our New York namesake, that nearly all the shots fired from the right side of the range had hit the target to the right of the bull's eye, while those fired from the left side had, with an equally singular persistency, hit the left half of the target. An examination of the steel-clad bullets extracted from the targets disclosed the fact that they had become magnetic, and this led the committee to entertain the theory that the deflection observed might have been due to electric influence exerted by the large number of telegraph and telephone wires which run along both sides of the range at Winterthur. Further experiment at the ranges of Thun and Berne proved this theory to be correct, and the remarkable discoveries made at these trials may effect another complete change in military tactics. The following account of one of the experiments is given by the *Journal de Génève*:

At Thun, authorities established parallel with the rifle range, at a distance of a little more than 40 yards, an electric current of 8,000 volts, carried along four steel cables. With a view of tracing the whole effect, paper circlets were placed at intervals of 10 yards along the line of fire. The first experiments were made with the Swiss model rifle of 1889. With this the influence of the electric current was at once apparent. In a distance of 260 yards the bullet took a lateral deviation of 24 yards, and after that the curve of the trajectory was still more marked. The second experiments were made with the Japanese 3·3 millimetre rifle of Count Yamagata, and they were still more decisive, the bullet being rapidly attracted to the electric wires, and following their course with absolute servility. Further attempts were made with artillery. The range selected was one of 3,000 yards. Two hundred yards in front of the target, but 40 yards to the side, was placed the electric battery. Every shot was diverted by its influence far to the side of the target. To be exact, the deviation was one of 14°.

Surely this must be taken *cum grano salis!*

Electricity in Mining.—A paper recently read by Mr. Cyrus Robinson, before the Western Pennsylvania Central Mining Institute and the Ohio Institute of Mining Engineers, states that where a mine is free from gas, and the roof ordinarily good, it does not require a very extended investigation to prove the advantage and economy of electricity over all other systems of power transmission for your coal mine. The following table, giving the cost of wire and pipe installed, based on the present market price of material and labour, shows very conclusively the superiority and economy of the electric system of transmission as compared with pneumatic:—

Horse-power delivered.	Distance in feet.	System of transmission.	Total loss in the line.	Cost of line installed.
100	5,000	Compressed air.	10%	$2,350.00
100	5,000	Electric, 250 volts.	10%	837.50
100	5,000	Electric, 550 volts.	10%	280.00

Guided by the above figures, the inclination would be to decide in favour of the electric 550-volt transmission, and if the vein of coal had an average thickness of not less than 5 feet, the decision would be correct.

The Inclosed Arc Lamp.—At the recent New York electrical exhibition, says the *Electrical Engineering*, the inclosed carbon type of arc lamp was out in all its glory, six different types made by as many different firms being shown, and not a single maker apparently showing any respect for the patents of any other maker. As is well known, the carbon in this type of lamp burns in a gaseous atmosphere in which the oxygen has been consumed, a further supply of oxygen being excluded by the presence of a gas and a partial vacuum. The result of excluding the oxygen is the entire consumption of the carbon (which ordinarily rapidly disintegrates under the influence of the fresh air blowing across the arc), thus lengthening the life for from 60 to 100 hours. Many are the advantages gained in having to trim a lamp less frequently than once daily, especially in stores where the dragging of a step ladder through the isles is a serious drawback to the use of the arc lamp. Unfortunately no means have yet been found for eliminating the impalpable white deposition that forms on the inner globe, gradually diminishing the amount of light radiated.

Self-Propelled Traffic Association.—Sir David Salomons presided on Wednesday, at the Cannon Street Hotel, over the statutory general meeting of this association.

Automatic Telephone Exchanges.—The *Pall Mall Gazette* publishes an interview with a "Mr. Apostoloff," who claims to have invented an automatic telephone exchange system. Mr. Apostoloff had previously invented a submarine vessel, which "remains to the present time a more or less unrealised idea," and "it is hoped that his new invention will meet a more practical realisation." After describing the advantages to be attained by the use of an automatic system, the interview concludes with a question as to the steps which are being taken to put the system into actual use? "Well, that is a matter," replied Mr. Apostoloff, "which hardly concerns me. It is the business of the parent syndicate to whom I have sold all my 41 patents. They would be able to answer such a question better than I should." Under these circumstances, it may be desirable to remark that whilst it is easy to describe the advantages of apparatus which works automatically, and not inherently difficult to design on paper some more or less complicated machinery which will apparently produce the desired result, there are decided advantages in drawing conclusions from "actual use." We shall be glad to have an opportunity of recording the working of the apparatus, and until such opportunity is afforded, it might be well for expectations to be minimised in case the automatic telephone system, like the submarine boat, should be destined to remain a "more or less unrealised idea."

Lighthouse Illuminants.—The Press Association understands that since the recent loss of the *Drummond Castle* the attention of the Government has again been called to the advantages of gas over electricity as an illuminant for lighthouses, especially in foggy weather. Stress is laid upon the following facts: (1) That when the electric light was first established at Dungeness the Trinity House yacht *Galatea* went ashore quite close to the light, those on board being unable to see it. (2) That in 1879 the *Bast* was wrecked close to the powerful electric lights at Lizard Point. (3) That in 1892 the *Eider* went ashore within a short distance of the electric light of St. Catherine's Point, I.W. (4) That the sad calamity to the *Drummond Castle*, resulting in such terrible loss of life, took place in close proximity to the electric light of Ushant, which the survivors say could not be seen. All these lights are stated to be most powerful, being dazzling bright in clear weather, but almost invisible in haze or fog.

Sir John Pender Dead.—It is with deep regret that we learn of the death of Sir John Pender, G.C.M.G., whose connection with nearly all the great Telegraph Companies, also with the Metropolitan Electric Supply and other undertakings, has brought him prominently before electrical men for many years past. He was a veteran in telegraphy, which owes its present position largely to his energy and daring in the early days of cable-laying. His death will not come as a great surprise to our readers, as he has been in a critical state of health for the past six months, and at telegraph company meetings we were told by the Marquis of Tweeddale that Sir John would never preside over another such gathering. He was 81 years of age. We hope to refer at greater length to his career and work next week.

Fifty Years Ago.—New York *Electricity* says that a bound volume of the *Mechanics' Mirror*, published at Albany, New York, in 1846, furnishes proof that the X rays are not a recent discovery. The October number of that magazine for that year contains the following:—

EXTRAORDINARY.

The following communication was made to the Academie Royale des Sciences de Paris at its last meeting by a Greek physiologist, A. M. Esseltja, who asserts that by the assistance of electric light he has been enabled to see through the human body, and thus to detect the existence of deep-seated disease. He has followed the operations of digestion and of circulation. He has seen the nerves in motion. M. Esseltja has imposed the name of "Anthroposcope" on his extraordinary discovery (?).

The editor added the following:—

We recommend a company of office-seekers to be formed for the purpose of purchasing this invention, as it would be of incalculable benefit to see if candidates for election defined their positions correctly, although we have no doubt it would be a pretty wild goose chase hunting up and down for the conscientious part of some of their consciences.

A Rapid Deep Sea Cable Repair.—A mid-Atlantic ocean repair on the Pouyer-Quertier cable was recently effected in a very expeditious manner by the Telegraph Construction and Maintenance Company. It was all the more creditable, says the New York *Electrical Engineer*, as it was on the much dreaded Flemish Cap, a spot usually avoided by Atlantic navigators on account of its frequent fogs and incessant gales. This company's vessel, the *Seine*, raised the St. Pierre end on May 15th, spliced on a piece, payed out and buoyed it the same morning. She then proceeded 40 miles to the eastward, and on May 17th raised the Brest end, spliced on, payed out, and arrived near the St. Pierre buoyed end the same night; but a dense fog coming on, the cable had to be cut and buoyed. The fog lasted four days, and on the weather clearing, the buoys were sighted, after some hours' searching for them. Early on the morning of May 22nd, the two ends were spliced together and the repair completed. This is claimed to be the quickest deep water repair ever made in the Atlantic, and had not the fog intervened, it would have been a marvellous one. The break occurred in June, 1895, and another vessel went out last autumn, but returned, as we have already stated, without having effected the repair, although she cut into the cable to the eastward of the Flemish Cap. The *Seine* on her way out from London had effected considerable repairs, 235 miles from Brest, on the same cable. She left London April 25th, called at Havre for cable, remaining there three days, and after effecting the two repairs above named, got back to London May 30th—exactly five weeks.

Appointment.—Mr. C. S. Vesey Brown, of the Sunderland electric lighting station, has been selected by the Electric Lighting Committee, from 53 applicants, for the post of electrical engineer to the Lincoln City Council, at £300 per annum. The matter comes before the Council shortly. We learn that the Sunderland Council want to keep Mr. Vesey Brown, and are likely to offer him £350 per annum, rising to £400, for a term of three years.

University College, London.—The Council have instituted a new professorship of pathological chemistry, and have appointed to the professorship Dr. Vaughan Harley, who has been working in the College for the last three years as assistant to Prof. Victor Horsley.

Correspondence.—We have received too late for insertion in this issue a letter from the British Electrozone Corporation, Limited, on "Electrozone." We are, therefore, compelled to hold it over until next week.

Correction.—The description of Herr Drexler's apparatus, summarised in the ELECTRICAL REVIEW, June 26th, appeared also in the *Elektrotechnische Zeitschrift*, Vol. xvii., p. 378. By a printer's error, Herr Drexler's name was spelt Drenler, in our article.

Personal.—Mr. E. J. Wessels, the general manager of the Standard Air-Brake Company, is now in Europe in search of business. He left the United States on June 30th.

Civil List Pension.—Among the Civil List pensions granted during 1896, we observe the name of Mr. Oliver Heaviside, £120; and Samuel Alfred Varley, £50. Congratulations!

NEW COMPANIES REGISTERED.

East Grinstead Electric Lighting Company, Limited (48,522).—This company was registered on June 26th with a capital of £15,000 in £1 shares, to adopt agreements with (1) O. Lucas and L. Pyke, (2) A. Hastie, A. H. Hastie, E. P. W. Hughes and E. Dayrell, and to carry on the business of electric lighting in the parishes of East Grinstead, Forest Row, and Worth, Sussex, and in the parish of Lingfield, Surrey. The subscribers (with one share each) are:—C. W. Bell, J.P., Yewhurst, East Grinstead; H. S. Martin, High Street, East Grinstead, chemist; W. H. Dixon, High Street, East Grinstead, chemist; A. A. Winser, London Road, East Grinstead, jeweller; C. M. Wilson, London Road, East Grinstead, draper; W. H. Hills, Fernleigh, East Grinstead, journalist; T. L. Manning, Brewery House, East Grinstead, brewer. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification £100; remuneration £150 per annum, divisible. Registered by Hasties, 65, Lincoln's Inn Fields, W.C.

South Manchester Electric Supply Company, Limited (48,567).—This company was registered on June 30th with a capital of £5,000, in £1 shares, to carry on at Withington and elsewhere in the neighbourhood the business of an electric supply company in all its branches. The subscribers (with one share each) are:—James G. Gloves, Altrincham, brewer; Nathanial Bradley, Whalley Range, Withington, merchant; Edward E. Johnson, 17, St. Ann's Square, Manchester, accountant; Robert G. Lawson, 18, Tib Lane, Manchester, solicitor; W. P. J. Fawcus, Manchester, engineer; Fred. J. Astbury, Manchester, chartered accountant; Henry Cardwell, Junction Street, Hulme, Crewe. The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first. Qualification one share; remuneration as the company may decide. Registered by T. T. Hull, 22, Chancery Lane, W.C.

Worsnop & Co., Limited (48,627).—This company was registered with a capital of £2,000, in £1 shares, to acquire and carry on the business of lamp manufacturers, electroplaters, japanners, and wholesale hardware, glass, and general merchants, carried on by H. Worsnop as "Worsnop & Co.," at the Carlton Street Lamp Works, Carlton Place, Halifax, and the business of retail lamp, oil, and hardware merchant, carried on at 4, Cheapside, Halifax, and to enter into an agreement with C. H. Worsnop. The subscribers (with one share each) are: C. H. Worsnop, 6, Carlton Place, Halifax, lamp maker; R. Maude, 20, Hyde Park Road, Halifax, gentleman; J. A. Worsnop, 11, Ward's End, Halifax, merchant; C. Worsnop, 107, Waterloo Crescent, Halitax, merchant; A. Parker, 65, Hyde Park Road, Halifax, engineer; J. Imbrey, 16, Hyde Park Road, Halifax, engineer; W. Fielding, 33, Hopwood Lane, Halifax, manufacturer. The number of directors is not to be less than three, nor more than seven; qualification, £50; remuneration as fixed by the governing director. Registered office, 8, Carlton Place, Halifax.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Direct Electric Generator Syndicate, Limited (46,342).—This company's statutory return was filed on May 6th. The capital is £100,000 in £1 shares; 45,979 shares have been taken up, and 41,799 have been issued as paid. £1 per share has been called on 4,180, and £3,830 has been paid, leaving £350 unpaid.

India-Rubber, Gutta-Percha and Telegraph Works Company, Limited (1,122).—This company's annual return was filed on June 10th. The capital is £812,000 in £10 shares; 50,000 have been taken up, and the full amount has been called and paid.

Liverpool Gas and Electric Fittings Company, Limited (10,337).—This company's annual return was filed on May 13th. The whole capital of £10,000, in £1 shares, has been subscribed for, and the full amount has been paid.

British Insulated Wire Company, Limited (32,594).—This company's annual return was filed on April 1st. The capital is £110,000 in 300 founders', 3,950 preference, 9,450 ordinary "A" and 8,300 ordinary "B" shares of £5 each. 298 founders', 3,720 preference, 7,152 ordinary "A," and 8,053 ordinary "B" shares have been taken up, and shares to the value of £49,110 have been considered as paid. The full amount has been called on 79 founders', 2,745 preference, and 6,577 ordinary "A" shares, and £47,005 has been received; 2 founders', 50 preference, and 52 ordinary "A" shares have been forfeited, and £265 received in respect thereof.

Reading Electric Supply Company, Limited (35,651).—This company's annual return was filed on May 30th; 4,014 shares have been taken up out of the capital of £75,000 in £5 shares, the full amount has been called, and £20,070 has been paid.

Southampton Electric Light and Power Company, Limited (26,354).—This company's annual return was filed on June 18th; 763 shares have been taken out of a capital of £30,000 in £5 shares, and £5 per share has been called; £3,760 has been paid, and £55 is in arrears.

Chamberlain & Hookham, Limited.—This company's annual return was filed on June 13th. The capital is £100,000 in £10 shares (of which 5,000 are "A" and the rest "B"); 1,000 "A" and all the "B" have been taken up, and the "B" shares have been considered as paid. £3 10s. per share has been called on the "A" shares, and £3,500 has been paid.

China and Japan Telephone Company, Limited (17,831).—This company's annual return was filed on May 22nd; 14,761 shares have been taken up out of a capital of £20,000 in £1 shares, and all have been issued as fully paid.

CITY NOTES.

The Consolidated Telephone Construction and Manufacturing Company, Limited.

A report to be presented at the fifteenth annual general meeting of this company, to be held at Winchester House, Old Broad Street, London, on Thursday, July 9th, 1896, at 12 o'clock noon, reads as follows:—

"The directors beg to submit the report and accounts for the year ending March 31st, 1896, and regret that the removal of the works and offices has caused the issue to be somewhat later than usual. The shareholders will bear in mind that the accounts now presented nominally represent one year's trading: in reality, owing to the suspension necessary in removing, a period of about nine months only is covered. The total receipts for the year on revenue account amount to £6,614 6s. 6d., including £3,209 0s. 11d. received in respect of the Edison Gower-Bell Telephone Company of Europe, Limited, Belgian law suit, and £1,750 transferred from revenue suspense account, being dividend declared payable on July 1st, 1896, by the Edison Gower-Bell Telephone Company of Europe, Limited. Deducting the usual expenses, amounting to £1,991 16s. 11d., this will leave a balance of £4,622 9s. 7d., against which your directors have decided to write off various items, as detailed in the revenue account, amounting in all to £1,821 16s. 6d., and to reserve the sum of £1,025 against loans. This will leave a net sum available of £3,023 9s., out of which your directors propose to pay a dividend of £1 10s. per cent., carrying a balance forward of £1,393 5s. 10d. The competition in the manufacturing business continues very keen. The lease of the factory and offices at Farringdon Road having expired at Christmas last, as foreshadowed in last year's report, the directors, after much search in the Midlands, decided upon the purchase of some works (freehold) at Coventry at an advantageous price. There is a considerable area of ground, capable of being built upon in the event of extension of manufacturing business. The saving in labour, fuel, rent and taxes, promises to be favourable, and though the boom in the bicycle trade has somewhat interfered with expectations under the first item, matters are satisfactorily settling down. Offices, &c., in London, have also been obtained upon satisfactory terms, and your directors propose that the subsidiary companies shall be asked to remove to the same building as soon as convenient. The lawsuit in Belgium carried on by the Edison Gower-Bell Telephone Company of Europe has had a satisfactory termination as regards certain of the infringing companies, and a large sum of money has been paid in respect of damages. Further vigorous action has been commenced against the other infringing companies. The subsidiary company, the Anglo-Portuguese Telephone Company, continues to show satisfactory progress, as will be seen by the following comparative statement for the year ending March 31st:—

Subscribers.		Rental.		Increase.	
1895.	1896.	1895.	1896.	Subscribers.	Rental.
2,439	2,494	£16,040	£16,408	55	£368

In accordance with the articles of association, Sir Alexander Armstrong, K.C.B., &c., retires by rotation, and being eligible, offers himself for re-election. The auditor, Mr. J. G. Griffiths, F.C.A. (Messrs. Deloitte, Dever, Griffiths & Co.), also retires, and offers himself for re-election."

Mr. C. L. W. FitzGerald (chairman) presided over the fifteenth annual general meeting of the above company held at Winchester House on Thursday, and in moving the adoption of the report, said that he could not disguise from the shareholders the fact that the profit on trading that year had really reached the lowest. That was due to the decrease in sale values in consequence of the keen competition. The total receipts for the year on revenue account were £6,614 6s. 6d., of which £3,209 0s. 11d. was received in respect of the Edison Gower-Bell Telephone Company of Europe, and £1,750 received for revenue suspense account. After deducting the usual expenses, and writing off various items, £3,023 9s. was available for dividend, out of which they recommended that a dividend of 1½ per cent. be paid, and £1,393 5s. 10d. be carried forward. As far as the manufacturing was concerned, if they continued as they had started that year, the balance-sheet would be very different next year. The report was adopted.

Electrical Power Storage Company, Limited.

The directors' report, to be presented to the shareholders at the seventh ordinary general meeting on Thursday, July 16th, 1896, at 4, Great Winchester Street, E.C., at 2.30 p.m., says that the net profit for the year ended May 30th, 1896, is £4,416 5s. 3d., which, with a balance of £170 18s. 2d. from last year, amounts to £4,587 3s. 5d., out of which the directors recommend the payment of a dividend of 5 per cent. on the ordinary share capital, which will absorb £4,243 3s. 10d., leaving £343 19s. 7d. to be carried forward. Provision has been made for the maintenance of buildings, plant, tools, &c., at a cost of £2,272 16s. 8d. The quantity of the company's manufactures sold during the past year shows a satisfactory increase. The company has acquired, after long and exhaustive experiment, the patents for the United Kingdom and an interest in certain foreign patents covering a new storage cell, in which considerable reduction in weight and space is obtained without increase of cost. The retiring director is Sir Daniel Cooper, Bart., G.C.M.G., who offers himself for re-election. The auditors, Messrs. James Meston & Co., chartered accountants, also offer themselves for re-election.

River Plate Electric Light and Traction Company, Limited.

The River Plate Trust, Loan and Agency Company, are authorised by the River Plate Electric Light and Traction Company, Limited, to receive subscriptions for an issue by the latter company at the price of 97½, of £120,000 5 per cent. debenture stock (part of an amount of £150,000 like stock authorised), redeemable by the company at six months' notice at 107½, interest being payable half-yearly. The prospectus points out that the stock will form a first charge on the whole of the company's assets, the River Plate Trust and Agency

being trustees for the debenture-holders. It is stated that the company's electric lighting stations are already in operation in the cities of the La Plata and Rosario, and a station is in course of construction at Tucuman city. The additional capital is for the purpose of erecting a station in Buenos Ayres, the requisite authorisation having been obtained. The company's authorised share capital is £300,000, in equal proportions of 6 per cent. preference and ordinary £5 shares. It is stated that the company's revenues have increased, and it is estimated that the net results of the four stations will not fall short of £24,000. The list closes at 4 p.m. to-day.

India-Rubber, Gutta-Percha and Telegraph Works Company, Limited.

A HALF-YEARLY general meeting of the shareholders of this company was held on Tuesday last at the Cannon Street Hotel, Mr. Matthew Gray presiding.

The CHAIRMAN said that the meeting was called for the purpose of obtaining the shareholders sanction to an interim dividend; but he would like to give them a little information as to the business the company had been doing during the last six months. The amount of business they had done during that period was about 10 per cent. greater than they had ever done in any previous half-year, and therefore they had every reason to be satisfied on that account. The business, however, had been rather unprofitable, because the raw material that they used had risen in price some 10 or 15 per cent., and the competition was so great, that they were not able to obtain as large profits as they could have wished. Still, on the whole, they had every reason to be satisfied. Their works were in first rate order, and they could turn out their contracts satisfactorily, and as far as he could see, there was no doubt that the business would go on increasing. In reference to the submarine cable work, they would remember that they had a number of cables to lay in Cuba, in the West Indies, and although they had very little time to do the work in, they managed to get the cables laid in time and satisfactorily, and they had received payment for the work. Since that time they had had an order for a considerable amount from the German and English Governments to lay a cable between Germany and England. It was a very difficult job, in consequence of the very shallow water that they were obliged to lay the cable in. He was glad to say, however, that they had done the work to the satisfaction of the English Post Office and the German officials. He might say that since the death of Mr. Robert Henderson and Mr. Jarvis they had been rather short of directors, but he was glad to say that Major Darwin had agreed to join the board, and he had no doubt he would do good work for the company. He proposed that an interim dividend of 2½ per cent., or 5s. a share, free of income-tax, be paid on the 8th inst.

Mr. SILVER seconded the resolution.

Mr. GRANT asked whether the company was—or was likely—to be involved in any legal matters with one of the cycle companies?

The CHAIRMAN replied that the directors had been advised that the Pneumatic Tyre Company was infringing two of their Palmer patents.

Mr. LAMONT said he supposed they might take it that the dividend proposed to be paid was simply a convenient arrangement, and that it was not meant to convey any indication of the profits made in the half-year.

The CHAIRMAN said that was so, for they did not take stock half-yearly.

Mr. LAMONT said there had been various rumours flying about as to losses and profits made by the company. It was said that they had made very large losses on rubber, and more recently it was rumoured that very large profits had been made in connection with the tyre companies. He would like to know whether there was any truth in those rumours?

The CHAIRMAN replied that they had neither made or lost money in rubber speculations, but they had been obliged to pay a higher price for the article—something like 15 per cent. more than before.

The resolution was then agreed to.

EXTRAORDINARY MEETING.

An extraordinary meeting was then held to consider the advisability of passing the following resolutions as special resolutions:—

(1) That articles of association 101, 102, and 103 be struck out, and the following articles substituted:—101. At the ordinary meeting in every year the directors shall lay before the company a profit and loss account and a balance-sheet containing a summary of the property and liabilities of the company made up to a date not more than three months before the meeting. 102. Every such balance-sheet shall be accompanied by a report of the directors as to the state and condition of the company, and as to the amount which they recommend to be paid out of the profits by way of dividend or bonus to the members, and the amount (if any) which they propose to carry to the reserve fund, and the account, report, and balance-sheet shall be signed by a director and countersigned by the secretary. (2) That in article of association 104, after the word "such," the words "report, account, and" be inserted. (3) That article of association 112 be struck out, and the following article substituted:—112. A firm of chartered accountants may be appointed auditors, and any casual vacancy occurring in the office of auditor shall be filled up by the directors by nominating a chartered accountant or a firm of chartered accountants to be auditor or auditors until the next general meeting. (4) That article of association 116 be struck out, and that there be added at the end of Article 114, "and to report to the company in general meeting thereon."

Mr. HUTCHINS, the solicitor, explained that the alterations were suggested by the auditor, who considered that they were necessary.

Mr. W. B. COCHRAN said it seemed to him that the alterations were not such as would benefit the shareholders. As the auditor was not present, he would suggest that the resolutions be postponed.

Considerable discussion ensued, and eventually on the motion of Mr. COCHRAN, seconded by Mr. LAMONT, the following motion was carried: "That the consideration of these resolutions be postponed till the 21st inst. at the same time and place, and that copies of the existing articles proposed to be changed shall be furnished to the shareholders before the meeting."

Stock Exchange Notices.—The Stock Exchange Committee have appointed a special settling day as under:—Tuesday, July 14th—Chelsea Electricity Supply Company, Limited—further issue of 12,000 ordinary shares, Nos. 20,501 to 32,500; County of London and Brush Provincial Electric Lighting Company, Limited—further issue of 10,000 cumulative 6 per cent. preference shares, Nos. 10,001 to 20,000. The undermentioned securities are to be quoted in the Official List:—County of London and Brush Provincial Electric Lighting Company, Limited—further issue of 10,000 cumulative 6 per cent. preference shares, Nos. 10,001 to 20,000; St. James's and Pall Mall Electric Light Company, Limited—£50,000 4 per cent. debenture stock.

The Gülcher (New) Electric Light and Power Company, Limited (in liquidation).—Mr. C. Fitch Kemp, liquidator, announces that a general meeting of the above-named company, limited, will be held at his office, 73, Lombard Street, E.C., on Wednesday, July 15th, 1896, at 12 noon, in order that he may lay before the said meeting an account showing the manner in which the winding-up has been conducted, and the property of the said company has been disposed of, and to hear any explanation that may be given by the liquidator, and also to pass an extraordinary resolution for determining the manner in which the books, accounts and documents of the said company, and of the liquidation thereto, shall be disposed of.

St. James's and Pall Mall Electric Light Company, Limited.—The directors have declared the following interim dividends for the half-year ending June 30th:—At the rate of 7 per cent. per annum on the preference shares, and at the rate of 5 per cent. per annum on the ordinary shares. The sale of electricity for the quarter ending June 24th, representing the supply at 6d. per unit, amounted to £10,657, as against £8,598 at the same rate for the corresponding period of 1895.

W. T. Henley's Telegraph Works Company, Limited.—The directors of this company have declared an interim dividend on the ordinary shares for the half-year ending June 30th at the rate of 6 per cent. per annum, free of income-tax, and on the preference shares at the rate of 7 per cent. per annum, less income-tax, both payable on September 1st. The transfer books of the company will be closed from August 21st to the 28th, both days inclusive.

United River Plate Telephone Company, Limited.—The report for the year ended March 31st states that the gross receipts amounted to £48,744, and the profit, including £4,620 brought forward, to £19,124. The directors propose to transfer £3,000 to depreciation and renewal fund, and recommend a dividend of 4 per cent, tax free, on the ordinary shares, leaving £4,524 to be carried forward.

Metropolitan Electric Supply Company, Limited.—The directors, on Monday, issued a prospectus inviting applications for an issue of 12,500 ordinary shares of £10 each at a premium of £2 per share; but on Wednesday it was announced that in consequence of the large subscription, the directors had decided to receive no more applications for new shares except from existing shareholders of the company.

Rochester and Chatham Electric Lighting Company, Limited.—There was no dividend to declare at the meeting of this company on 30th ult., and the chairman stated that there was also a lack of capital. He professed, however, full confidence in the future of the company. Its position was one of absolute safety, and the dividends which were looming in the near future would surprise everyone.

Globe Telegraph and Trust Company, Limited.—The directors recommend a dividend of 3s. 9d. per share, leaving about £1,000 to be carried forward.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending July 5th, 1896, were £881; week ending July 7th, 1895, £915; decrease, £34; total receipts for half-year, 1896, £881; corresponding period, 1895, £915; decrease, £34.

The Direct Spanish Telegraph Company. The estimated receipts for the month of June, 1896, were £1,960.

The Great Northern Telegraph Company. The traffic receipts in June, 1896, were £25,600; 1st January to 30th June, 1896, £139,600; corresponding months, 1895, £149,200; corresponding months, 1894, £129,800.

The Liverpool Overhead Railway Company. The receipts for the week ending July 5th, 1896, amounted to £1,286; corresponding week last year, £1,250; increase, £36.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 3rd, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,855.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation July 1st.	Closing Quotation, July 8th.	Business done during week ended July 8th, 1896. Highest.	Lowest
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104 xd	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	9 — 10	9 — 10	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	48 — 50	49 — 51	50⅝	49
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	92½ — 93½	92½ — 93½	93¼	92⅜
2,993,560£	Do. do. Defd.	Stock	...	...	...	9 — 9⅛	9 — 9⅛	...	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6¼% §	7 %	...	15 — 15½	15 — 15½	15 5/16	...
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	5 %	111 —115 xd	111 —115	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	...	3½ — 3⅝	3½ — 3⅝	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	160 —170	160 —170	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	1½%	1/16 — 3/16	1/16 — 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½ — 13½	12½ — 13½	12⅝	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19½ — 20½	19½ — 20½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½ — 4½	3½ — 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	106—109%xd	106 —109 %	...	...
60,710	Direct United States Cable, Ltd.	20	2⅝% §	2 %	...	9¾ — 10½	9¾ — 10½	10	9⅞
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6¼% §	6¼%	...	17 — 17½	17 — 17½	17½	17 5/16
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	...	18½ — 18⅝	18½ — 19	18⅝	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	...	106 —109	106 —109	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	131 —134	131 —134	132½	132
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17½ — 18	17½ — 18	17¾	17⅝
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	100 —104 xd	100 —104	103¼	103
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	101 —104 xd	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	132 —135	132 —135	134	132
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	100 —104 xd	100 —104	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	101 —104 xd	101 —104	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	106 —109	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	111 —114 %	111 —114 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅝% §	4½%	4½%	10½— 11	10½— 11	10⅞	10⅜
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	6 %	17 — 17½	17½— 17⅝	17 7/16	17⅛
150,000	Great Northern Teleg. Company of Copenhagan	10	8⅜%	8⅜%	10 %	23½ — 24½	23 — 24	...	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	52 — 55	52 — 55	54½	53⅜
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	111 —113	111 —114	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5¼%	7⅜ — 7⅝	7⅜ — 7⅝	7 13/16	7 11/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	16½ — 17½	16½ — 17½	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6¾ — 7	6¾ — 7	6 13/16	...
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —108 xd	105 —108	106½	105
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4¼%	5 %	11/16 — 13/16	¾ — ⅞	13/16	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	1 5 — 109xd	.06 —109	...	..
11,839	Reuter's Ltd.	8	0 %	*nil*	5 %	6½ — 7½	6½ — 7½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	...	3½— 4	3¾ - 4¼	3¾	3 3/16
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	99 —104 xd	101 —106	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	4 %	7 — 8	7 — 8	...	...
236,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 —106	103 —106	105	...
30,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	*nil*	1 — 2	1 — 2	1¼	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	8 %	93 —103 xd	93 — 103	102	...
54,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	3 %	8¾ - 9¼	8¾ - 9¼	...	...
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6¾ — 7¼	6¾ — 7¼	7	6 15/16
33,129	Do. do. do. Def. Ord.	7½	...	1 %	1 %	2¼ — 2¾	2¼ — 2¾	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	105 —109	105 —109	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	105 —109	105 —109	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅞%	½%	⅞%	1 — 1¼	1⅛ - 1⅜	1¼	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11½ - 11¾	11½ - 11¾	11⅝	11 5/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9½ — 10½	9½ — 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	107 —110 xd	107 —110	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	110 —115	110 —115	...	...
164,300£	Do. do. 6 % Ster. Bonds ..	100	6 %	6 %	6 %	102 —105	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	8¼— 8⅜	8¼— 8⅜	8⅜	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7⅞— 8	7⅞— 8	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4 %	114 —116 xd	114 —116	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	14½— 15½	14½— 15½	15¼	14⅞
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17	16¾ — 17¼	17	...
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	132 —136 xd	133 —137	135½	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	*nil*	8½— 9½	8½— 9½	...	...
10,000	Do. do. do. 6% Pref., £8 pd., 40,001—50,000	10	...	...	6 %	13½— 13⅝	13½— 13⅝	13½	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	4 %	13½ — 14½	13 — 14	13⅜	13¼
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	119 —121 xd	119 —121	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	9½— 10	10 — 10½	10½	9⅝
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	11¼— 11⅝	11⅝— 12¼	12	11⅝
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9½— 10½	9½— 10½	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	10¼— 10⅝	10¼— 10⅝	10 11/16	10½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, July 1st.	Closing Quotation, July 8th.	Business done during week ended July 8th, 1896. Highest.	Lowest
£0,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	£	5 %	2½%	...	1½— 1⅝	1½— 1⅝	1 3/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	£	6 %	3 %	...	1½— 1¾	1½— 1¾	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	112 —115	112 —115	...	...
630,000£	City and South London Railway	Stock	1½%	1½%	1 3/16 %	43 — 45	43 — 45	44¼	43
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	£5	3 % §	*nil*	...	2 — 2½	2 — 2½	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	£5	7 %	5 %	...	1½— 1¾	1½— 2	...	...
17,139	Do. do. do. "A" Shares 01—017,139	£5	7 %	5 %	...	2½— 3½	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	...	103 —105xd	103 —105	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	£2	*nil*	*nil*	...	1½— 1½	1½— 1½	1 7/16	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	£2	7 %	7 %	...	2½— 3	2½— 3	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	£2	*nil*	*nil*	...	3/16— 1/4	3/16— 7/32	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	£2	*nil*	*nil*	...	1/8— 1/8	1/8— 1/8	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	£10	*nil*	*nil*	...	10½— 11½	10½— 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	£10	5 %	6 %	8 %	17 — 18	17 — 18	18	17½
3,000	Do. do. do. 7% Pref.	£10	7 %	7 %	7 %	17 — 18	17 — 18	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	109 —114	109 —114	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	£10	12½%	10 %	10 %	21 — 23	21 — 23	22½	22
300,000	Do. do. do. 4 % 1st Mort. Debs.	£100	...	...	...	105 —108	105 —108	107	...
37,500	†Liverpool Overhead Railway, Ord.	£10	1 %	1½%	2½%	13 15/16— 14 1/16	14 — 14½	...	...
10,000	† Do. do. Pref., £10 paid	£10	5 %	5 %	5 %	17⅛— 17⅜	17⅛— 17⅜	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	£12	20 %	20 %	15 %	38 — 41	38 — 41	40½	39
150,000	Do. do. do. 5 % Bonds, red. 1899	£100	5 %	5 %	5 %	102 —105xd	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	£10	...	...	...	8 — 8½	8 — 8½	8 3/16	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1893—7½%; 1894—5%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅞—6⅛.
Electric Construction Corporation, 6 % Debentures, 102—104xd.
House-to-House Company (£5 paid), 4—4½.
Do. do. 7 % Preference, of £5, 8—8½.
Do. do. 4½% Debentures of £100, 107—109.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 9½—9⅝; 1st Preference Cumulative 6 %, £5 (fully paid), 7⅞—8.
Liverpool Electric Supply, £5 (fully paid), 8—8½.
London Electric Supply Corporation, £5 Ordinary, 1—1½.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7½—8.

Bank rate of discount 2 per cent. (February 22nd, 1894).

SOME NOTES ON ROPE DRIVING.

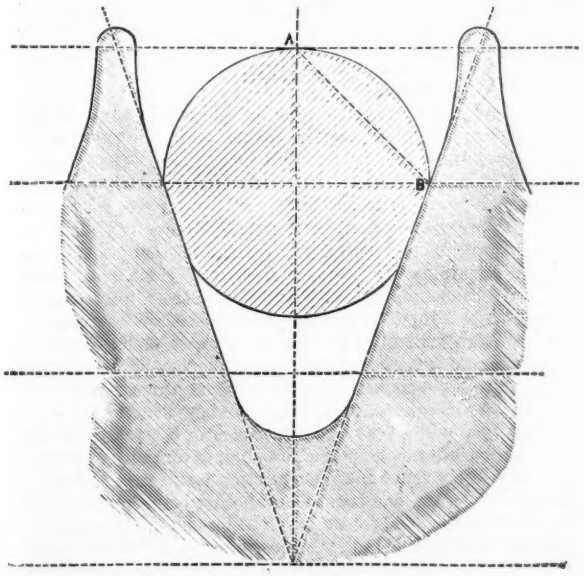
The use of ropes in dynamo-driving has been far from common in the past, but is estimated by some as likely to be more common in the future. The truth is that the dynamo differs much from most pieces of machinery of equal bulk. An armature of small size puts an immense resistance against the driving force, and most armatures have very small momentum as compared with the power absorbed in the driving of them. Yet in electrical work, perhaps not in lighting, but at least in traction and other power transmissions, there are apt to be very great sudden fluctuations of the power absorbed. Where there is no fly-wheel the stress thus produced is transmitted immediately to the furthest point of the machinery, and in direct connected engines, the stresses which come upon the crank shaft are very severe, and quite sufficient to account for the many failures which have taken place in such shafts. The stresses make no outward and visible sign other than any slowing down of speed they may bring about. In case of belts or ropes which are placed between an engine and a dynamo, and are called upon to suddenly take up or give out stresses of large amount, the fact is made prominently visible by the wave which is thrown into them, and heavy ropes apparently make a sudden leap which is really dangerous. This points to the necessity of using fly-wheels on armature spindles exactly as they are used in cases of direct driving. But there is another aggravating cause of trouble. It is frequently the case that dynamos are placed considerably below the engine. This is a mistake. When so placed any wave thrown off the upper side of the driving rim has all its centrifugal and upward tendency allowed full play. When the dynamo is above and a wave is thrown off from the fly rim the effect of gravity tends to pull the rope down against its centrifugally applied upward wave. As a result the rope travelling upward to the dynamo pulley is urged by gravity against the face of the driven pulley, whereas, in the case of the downward moving rope, gravity is opposed by the inertia of the rope, and the wave may reach the driven pulley and get half round it before it gets down to its groove. Wherever possible the slack side of a rope should travel uphill. In short, it is unfair to blame ropes for the fault in design which is evidenced by the neglect to apply a fly-wheel. Otherwise the important points in rope driving are the rope diameter, the ratio of rope to pulley diameter, the form of grooves, the distance apart of shaft centres, the material of the ropes, their velocity, and the unit stresses in them.

Messrs. W. Kenyon & Sons, of the Chapelfield Ropery, Dukinfield, who have made a special study of the subject, and are the makers of the patent inter-stranded rope which bears their name, consider that though the diameter of the smallest pulley should be at least 30 times that of the rope for cotton and 45 times for hemp, it is nevertheless desirable to make the driven pulley diameter 50 times the rope diameter, and the driving pulley 150 times. As to this, however, much must hang upon other considerations. In the early days of rope driving, ropes were commonly 2 inches diameter, but thinner ropes are stronger per unit of sectional area. Large ropes, however, have greater durability, and become less worn in proportion to their weight than do thin ropes, and the general result of now many years experience has been to fix upon 1⅝ths inch as a happy medium. For large powers, seeing that ropes of large diameter will give a much greater power per unit of breadth of face of rim pulley, it is clear that the length of a heavily loaded shaft can be kept to a minimum by using large ropes. Large ropes also hang better and in more even curves, and we think that nothing should be used of less size than 1½ inch where possible, and this would call for 45 inch driven pulleys in order that the minimum ratio of pulley diameter to rope diameter may be maintained.

The form of the groove is a matter that requires consideration. Continental makers often make the bottom of the groove flat. English practice is to make it round. This is not a matter of much importance. What is important in the matter of grooves is that every groove shall be of the exact same form, and they should be so made that the ropes

wedge into and release themselves without much friction. Moreover, the ropes must not touch the bottom of the groove. From 40° to 45° is a usual angle to adopt. Messrs. Kenyon, to whom we are indebted for the annexed copyright method of designing the grooves, use an angle of about 41½°, obtained by the construction shown in the annexed figure as follows :—

Draw the circle of the rope with intersecting vertical and horizontal axes. Draw the chord, *a b*. From the centre of the rope mark off on the vertical line a distance equal to *a b*, this will give the centre of the root circle. Next mark off a further distance equal to *a b*, this gives the point of intersection of the sloping sides. Draw these sloping sides through the ends of the horizontal diameter of the rope and carry them forward till they cut the dotted line drawn horizontally across the top of the vertical diameter of the rope. The intersection is the centre of the narrow flange curve. The flanges are made thin and joined by an easy curve to the inclined sides of the grooves; but this curvature should cease as shown at a distance about equal to $\frac{1}{6}$th the rope diameter above the horizontal diameter of the rope, for it is of importance that the groove sides should be flat and not curved or they will prevent the rope from bedding itself to shape. It will tend to revolve, and a rope which rotates about its own longitudinal axis wears more and never assumes the solid shining appearance which characterises a well-wedged



1⅝ Dia. Rope, FULL SIZE

rope. We do not say this is the sole cause of rotation but it is believed to have an important influence and, therefore, grooves should have flat sides. In the diagram the flattening of the rope circle by the inclined sides about represents what actually takes place in shaping a rope to its groove. Any angle sharper than about 40° would cause too severe a wedging action; any more obtuse angle than 45° would too seriously reduce the wedging action. It must be noted that as a rope enters a groove slack and leaves it stretched, and therefore so much smaller in diameter, the tendency is for it to occupy a lower place in the groove as it nears the point where it leaves the pulley again. The rope lies as it were between the sides of a very long pair of inclined planes and it is thus held from slipping by this longitudinal wedge action as well as by the frictional grip of the inclined sides. The base curve of the groove is of course simply made to touch the sloping sides; this fixes its radius. Sometimes the vertical portion of the flanges is omitted, and the sloping sides are simply joined by a curve which does not always extend so high as the top of the ropes. These do not give quite so great safety against jumping of the ropes from groove to groove. To be easy in working, ropes must not be too short, the distance apart of the shafts being conveniently three times the joint radius of the driving and driven pulleys. Any excess over this is apt to allow too much sag in cases of horizontal driving, and generally too great length is not desirable, especially in dynamo work, as the large amount of slack is a source whence a sudden change of stress may give rise to wave motion and shock. Too short a distance between shafts is, however, undesirable, especially where the pulleys differ considerably in diameter as it reduces the grip arc on the small pulley to what may prove too small to secure a proper grip.

The length given is, therefore, a fair average. In a factory of several floors the ropes to the upper floors are obviously much longer than the others, but the distance in plan is not necessarily so, and the sag of the slack side is not therefore excessive. Direct vertical driving is to be avoided where possible. When a nearly direct vertical drive is unavoidable allowance has to be made for the fault by using more ropes to the extent of 15 or even 20 per cent. or more, while, where the slack side in a horizontal drive is the lower side, a percentage of 10 to 15 per cent. should be added to the number of ropes to make up for the less desirable arrangement. In calculating the power that a rope will transmit, it must be remembered that there is a wide margin of strength, but for ordinary speeds the horse-power that a rope may be safely made to transmit may be set down as H.P. $= \frac{d^2\ s}{5{,}000}$, where d is the rope diameter in quarter inches, and s is the rope velocity in feet per minute. Thus a 1¾ rope at 5,000 feet figures out at nearly 50 H.P., and though speeds of 6,000 and even 7,000 may be employed, it must be remembered that for the stresses used in practice 5,000 feet per minute is the maximum velocity beyond which the stresses due to centrifugal tension increase at a faster rate than the increase of power. Beyond 5,000, therefore, a rope is really less efficient. The limits of practice are conveniently from 2,000 to 6,000 feet velocity, but there is no objection to slower speeds when needful. One should aim to get a speed of 3,600 to 4,800 where possible. Between these limits a rope has practically an equal efficiency. As regards material the first driving ropes employed in heavy driving were of hemp, because it was in Dundee that rope driving was first employed. Americans use manilla very much, but manilla is a very rough fibre, and works its own destruction, and nothing has proved so good as cotton. Egyptian and American cotton are those most suitable. There is practically no difference between them.

As regards the question of electrical driving it may be thought that an elastic rope which has a considerable slack will be more objectionable than a tighter rope. In this respect we understand that arrangements are being made to test the properties of Rhea fibre as a material for driving ropes. Rhea fibre, which is the strongest fibre known, and is a fine smooth fibre of great length and capable of being spun fine like cotton, has exceedingly little elasticity and would therefore make ropes that would stretch very little, and would, at the same time, be as free from internal friction as cotton.

The question of strands is one of importance. Anyone who will draw three circles in contact, and four circles in contact, will see at once that there is only one arrangement for the three circles in a rope. With a four-strand rope two opposite circles may touch, and the other two may not touch, and a four strand rope tends to become irregular in shape. There is, therefore, no reason for having more than three strands to a rope. They form a more solid rope than any other number. A four-strand rope requires a core to help it in its proper laying. A core makes a rope stiffer, and, moreover, it is very apt to take above its share of load. This may break it, and the vacant gap between its broken ends is occupied by the rope getting out of shape and the space becoming filled by one of the strands. Other numbers of strands also require a central core, and are exposed to the same liability to get out of shape as the four-strand rope, and three strands have now become the standard.

With a material like cotton, the pliable nature of the strands allows them to so interbed themselves as to practically fill solid the central space, and, after some time of working, a rope which has become bedded assumes an almost triangular shape and gets hard and compact, and, if suitably dressed with a minimum of dressing, becomes polished on its bedding sides and runs almost like an iron bar in appearance. Dressing should only be very sparingly applied, and on no account

in sufficient quantity to soak the rope. Dressing contains plumbago, and while this helps the rope to become polished the liquid portion of the mixture is supposed to be present simply in sufficient quantity to lay any fluffy ends. A mixture much used on machine ropes is one of plumbago and treacle. Oil must not be used. It is usual when making a cotton rope to lightly serve with plumbago and tallow the outer surface of each strand before laying up the rope, but this is all that is needed; there should be no composition between the individual threads.

It may be added, in regard to speed and the folly of running ropes, by intention, at specially high speeds, that even the speed of maximum efficiency is really not the most economical speed. It allows of the use of minimum rope pulleys, but the wear of a rope is a result of its speed, and, at 5,000 feet the wear is 25 per cent. additional to the wear at 4,000 feet, yet the working capacity of the rope, allowing for centrifugal stresses, is under 3 per cent. more at 5,000 feet velocity than at 4,000 feet. Indeed, the wear may be doubled by raising the speed from 2,500 to 5,000 feet, and less than 40 per cent. will be added to the capacity.

The Lancashire practice in rope gearing has so fixed the ratio of working stress in the rope to its weight per foot and centrifugal stress that the velocity of maximum capacity coincides with the 80 feet per second usually considered as the maximum safe velocity for a cast-iron rim. The maximum velocity has been found to produce the best results, but here again the results so obtained are merely a coincidence. They are good because of the excellent fly-wheel effects which accompany high rim speeds, and not necessarily because of the high rope speed, and, speaking generally, there have always been so many considerations in the whole question of main driving, that certain results have been very commonly attributed to wrong causes. Ropes have been run with perfect satisfaction up to speeds as high as 7,000 feet per minute, developing, per 1¾-inch rope, some 93 H.P. This implies not simply an increase in the centrifugal tension, but also in the working tension, and is not to be recommended on the score of durability, because at that speed the tension on the rope is 427 lbs. due to centrifugal tension; 438 due to working side pull, and probably 86 lbs. due to the slack side tension, a total of 950 lbs., which is quite 50 per cent. more than usually allowed.

Early rope installations attempted to employ ordinary shaft bearings, and a good deal of trouble naturally followed with heated necks. The high rotative speeds coupled with the heavy side pulls of the ropes, and the absence of the vibration which was set up when toothed wheels were used, combined to cause trouble, and bearings for rope pulley second motion shafts have grown in length up to five diameters of the neck. To prevent bending and enable a shaft to be of minimum diameter the supports have been placed close to the pulleys, or have been made double with enlarged central diameter of shafts, and continuous oiling pumps are fitted to maintain a constant flow of oil over the necks, the pumps being driven by bands from the shafts themselves, a pump and an oil box and circulating pipes being fitted for each bearing. The necessity for large area of bearings arises from the steady pull of the ropes and the very continuous pressure upon the brasses tending to exclude oil. Brasses need to be suitably channelled to lead the oil in, but there should be no through oil hole drilled into the oil channels of the loaded brass, nor should the channels extend to the ends of the brasses whereby a too free escape of oil is allowed.

In the question of multiple independent ropes or of the single rope reduplicated, there are, of course, arguments to be advanced on both sides, but the weight of evidence and experience is in favour of the multiple system. With this system the grooves of the driving and driven pulleys are exactly opposite to each other, and this is not the case in the system of re-duplication where the grooves have a lateral relative displacement of half a groove. The rope entering No. 1 groove of the driving pulley leaves No. 1 groove of the driven pulley it is true, but the rope as it enters the No. 2 driven groove has left the No. 1 groove on the driver, and finally when every groove is followed out the rope has to be brought back to the starting point right across the full breadth of the driving drum, and there must be a carrier pulley for this purpose. The angular direction of the ropes relative to the grooves causes lateral rubbing and tends to cause the ropes to revolve upon their own axes. This tendency is mischievous, for when a rope revolves it never beds itself to shape in the grooves, and will not have the endurance of the bedded rope. Where the single rope is employed it is wound, the necessary number of turns, round and round all the pulleys to be driven, every turn, of course, passing round the main drum. Thus, with the grooves in the main drum and four equal driven pulleys, each driven pulley takes four laps of the rope, which also is carried once round a sheave carried by a tension carriage. The advantage of this system lies in the ability to regulate the slack side tension to a uniform minimum in each lap of rope, and it is more suitable also for vertical drives, the tension carriage serving to take up all the surplus slack which would otherwise cause the ropes to slip. But for most ordinary straightforward work the independent ropes are preferable. It is probable that the system of reduplication, more used in America than here, was introduced to America from Germany. English arrangements of machinery are rarely made of the style which calls for direct vertical driving, and efforts are generally made to secure a sufficient horizontal distance between shafts to allow of comfortable working with not unduly tight ropes. In such cases the system of separate ropes has so many advantages over the reduplicated single rope, that it is not worth while considering for such situations a system which requires the complication of a tension carriage. In dynamo driving, especially where the dynamo is provided with an adjustable base, allowing an unduly slack set of ropes to be tightened up, the independent rope system is freed of the one fault that might be urged against it.

When the strength of a rope is considered, it is obvious that if a cylinder of parallel fibres or yarns be twisted together, the external yarns will be made much shorter than the inner ones, so that in a strand thus simply twisted together, the outer yarns will be exposed at the same time to the heaviest stress and the greatest amount of wear. The tendency of this is to cause a rope to wear much more quickly than it would otherwise do. If we take a three strand rope, each strand is equally situated as regards position and twist, and as regards the strands there is no weakening. Now Messrs. Kenyon & Sons, recognising the evil of unequal stress, brought out their interstranded rope. In this rope, each of the three strands is composed of a considerable number of smaller strands coiled layer by layer upon an inner set of strand. If a piece of rope be cut off, say exactly 4 inches long, each of its three strands will measure a trifle over 4 inches, but they will all be equal because they will all be equally placed in the rope. If now one of these strands be peeled, its outer layer can be removed and will freely leave the inner portion; this may in turn be peeled and so on, one layer after another being removed, and if the little strands of each layer be measured when laid out straight, it will be found that those first peeled off will be the longest. This is correct, because they have as many turns per foot length of rope, and are wrapped round a larger circumference. In the patent interstranded rope, therefore, every small strand has a length suitable to its place in the rope and takes its proper stress, and every thread in the rope follows its proper course and does not vary from its position throughout the whole length of a rope, unlike where a rope strand is simply composed of so many thousand threads twisted together with less attention to this important point.

In tests made by Kirkaldy, a rope of 1¼ inch diameter broke at 12,017 lbs.

This system of manufacture facilitates the making of ropes any length. Numerous ropes have been made 4,000 feet long without a joining, and from 1⅜ to 1¾ diameter. In fact, the limit of length is that of convenience of carriage of the bulky roll.

In splicing a rope a special man ought to be employed, and at least 72 diameters of a rope ought to be the length of a splice. Carefully spliced, with due regard to the gradual tapering down of the strands, a splice neatly finished is very little less in strength than the body of the rope, and after a short run it is often impossible to find the spliced portion. The approximate weight of a good cotton rope is as follows:—

Diameter of Rope.	Weight per foot.	C.
1¼″	0·5 lb.	64
1⅜″	0·6 „	53
1½″	0·72 „	44
1⅝″	0·844 lb.	38
1¾″	0·98 „	33
2″	1·3 „	25

a good figure to remember, being that a $1\frac{3}{4}$ rope weighs 1 lb. per foot, and other sizes in the ratio of their diameters squared. The coefficient, C, is useful in determining the stress due to centrifugal force for any velocity, the square of the velocity in feet per second divided by C, giving the stress in the rope due to the speed, and serving to caclulate the stress for any speed from which the margin remaining for useful work can be deduced. Thus for a $1\frac{3}{4}$ rope the centrifugal tension at 80 feet per second is $\frac{6400}{33}$ or 193 lbs.

The maximum usual tension is 600 lbs. in such a rope. Deducting a tenth of this for the slack side tension, leaves 540, from which, if 193 be taken, we have left 347 lbs. working load. For a total 600 lbs. stress the maximum speed of the rope would be found at about 77 ft. per second, but when wear and tear is taken to account, the paying maximum speed will be found even less than this, the true value being dependent upon the cost of ropes and the cost—initial—of the pulleys, &c. It must be noted also that at a high velocity the initial tension requires to be greater, because of the reduced grip due to centrifugal tendency, and this again tends to lower the speed of maximum efficiency.

It is a mistake to suppose that rope gearing absorbs so very much more power than belts or toothed gears. A roped engine may show a greater friction diagram, but the cause is one rather of fly-wheel weight, and the heavy rims used for ropes have been found very effective in promoting steady running, and necessarily add to the friction of an engine. For steady continuous work the year through and freedom from breakdown and anxiety, the use of large engines and rope gearing can hardly be rivalled by any other system. But armatures ought to have their fly-wheels in the same way as they are supplied in direct driving, namely upon the spindle of the armature.

SINGLE-PHASE ALTERNATE CURRENT TRANSFORMER IN PRACTICE.*

By A. F. BERRY.

(*Concluded from page* 846, Vol. XXXVIII.)

The Open Circuit Loss,

Or the loss that occurs when no energy is being taken from the secondary coil; this loss is made up from the following sources:

(1) $C^2 R$ of primary.
(2) Leakage of current over coils due to damp, &c.
(3) Eddy currents in the iron, and
(4) Hysteresis loss in the iron.

No. 1 will rarely account for more than 0·1 per cent. of this total measured loss.

No. 2 is a very variable, but not always despicable loss.

No. 3 will contribute as a rule from about 12 to 20 per cent. of the total loss.

No. 4 is a loss about which perhaps the least is known, and therefore most said, and is usually accountable for from 75 per cent. up to 85 per cent. of the total open circuit loss.

This question of true watts, as they are called, ought first of all to be studied in its entirety, and its several constituents examined in detail when time so spent has a minimum value.

If we measure the value of the volts maintained at the primary terminals, and also the current traversing the primary coils of a transformer, and multiply the two values together, we shall obtain a quantity which represents apparent watts only, but which can be converted into true watts, representative, by multiplying by another factor, the true watts being equal to $V A \cos a$, where a is the angle of lag of the current, A, behind the volts, V; we shall be obliged to discuss the reason why this formula gives us true watts in a very brief manner, and I think that to quote a proof of the same is the quickest and best method of leaving this formula.

It will be generally admitted that it is obvious that where a difference in phase exists between the E.M.F. and current curves the mean of the products of an infinitely large number of instantaneous values of E.M.F. and current, such as e, i, will represent the true watts expended in any circuit in which a lag of current behind E.M.F. exists.

If E and I = max. values of E.M.F. and current respectively,
$p = 2\pi \times$ number of $\sim$ per second
$= 2\pi n$,
and a = angle of lag of current behind E.M.F.,
and e and i = instantaneous values of E.M.F. and current.
Then
$$e\,i = E \sin pt\, I \sin (pt - a)$$
$$= E I \sin pt \sin (pt - a)$$
$$= \frac{E I}{2}\left\{(\cos a - \cos (2\,pt - a)\right\}$$

By carrying e and c through one complete cycle and summing series of n values of e and i

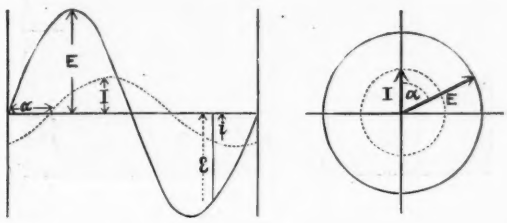
n = infinitely large number.

Mean watts $= \frac{1}{2} E I \cos a$.

Now voltmeter reading $= \frac{E}{\sqrt{2}} = V$.

and ammeter reading $= \frac{I}{\sqrt{2}} = A$.

$\therefore W = V A \cos a$.

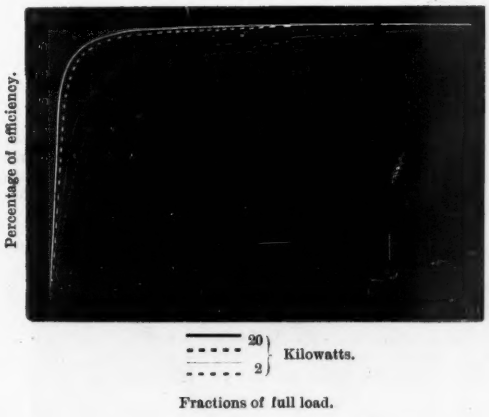


Why the current lags behind the E.M.F. is, I hope, not necessary to discuss, although one might gather from the muttered monosyllable used by the exceedingly practical engineer, when this difference in phase is brought up for his stupefaction, that he does not find the mention of the word "lag" so soothing as that of an expression equally brief and more generally used.

In the same way it is unnecessary to enter into the question of why we do not, in England, see a single two-phase system given a trial, to say nothing of polyphase systems.

Having agreed that energy absorbed in an inductive circuit is equal to $V A \cos a$; we must note that in considering the magnitude of this open circuit loss we have to bear in mind one very important fact, viz, that this loss varies with the time the instrument has been in use.

The curves of efficiency given for two different sizes are an illustration of the effect of this increased loss upon the curve representing efficiencies at different loads.



These curves are an average of a very large number of tests on different types of transformers by our bossted makers; the dotted curve is that taken after a year's continuous working, the white full curve being that taken before the transformer had been doing any work.

One fact is very clearly demonstrated by these and similar curves, and that is, that the end is not yet in the way of transformer improvements in our old established manufacturing firms.

No explanation is, I hope, expected, and I will merely call your attention to the fact that it is at light loads that the efficiency is so much reduced, and it is this that makes the case so much more serious, those light loads having such an awkward way of confronting central station engineers for a great deal too much of each 24 hours.

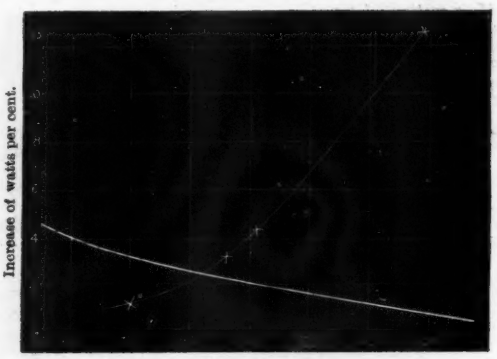
Mr. Partridge in an article in an *Electrician* of April, 1894, was the first person to publicly call attention to this increased loss, but it at once became a *fact* as old established as the Chinese race, but I believe only one firm produces instruments which have not shown this increased loss.

You will not suppose for one moment that, because this time increase is so lightly regarded by some who have good reason for their levity, it is one to be disregarded, for not only does it influence the efficiency, but also length of life, in a manner that is very apparent.

A question which might very naturally suggest itself is—how do these true watts vary with temperature? For it must be evident that a transformer core which is constantly having energy expended in it, will have a temperature exceeding that of surroundings by an amount proportional to the work done on it, and the capabilities of the transformer for dissipating heat developed within it.

* Paper read before meeting of student members of Institution of Electrical Engineers, May 8th, 1896.

I have experimented largely on different instruments on this subject, and the curves shown will give you some idea of how *not* to generalise on the results of one or even several experiments.



I believe it is sometimes understood that the iron loss or true watts is reduced with increased temperatures, but this may or may not be true, and one or two experiments are a sandy and shifting foundation on which to base such a statement.

Let us in dealing with the effect of temperature on true watts, see how it *may* affect the constituent parts of this loss.

It may increase the eddy current loss by causing greater pressure between neighbouring stampings forming the iron core, which will expand with heat.

It may diminish the loss by increasing the resistance of the actual metallic iron of the core.

It will increase the copper loss owing to increased ohmic resistance, the heat being conducted from iron to copper.

It will decrease hysteresis loss in a degree depending largely on the quality of the iron used.*

It may cause moisture to be temporarily expelled from positions on core $\left\{\begin{matrix}\text{or}\\\text{and}\end{matrix}\right\}$ coils, thus reducing loss of power.

Open circuit loss in any particular transformer varies, in a way that might be anticipated, with the primary impressed E.M.F.; theoretically, the equation to the curve connecting the watts with impressed E.M.F. should be

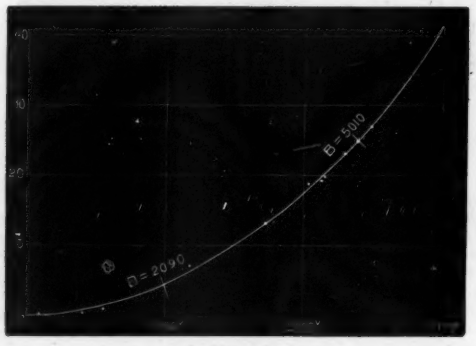
$$W = a\,E^{1\cdot6} + b\,E^2,$$

for the induction, B, varies as E,

and watts = hysteresis loss + eddy current loss,

i.e., $w = a\,B^{1\cdot6} + b\,B^2$.

There is shown a curve which is drawn through calculated points, and the close proximity of points derived from actual measurements is a proof of uniformity of the wattmeter and voltmeter readings. Crosses are placed on the curve indicating the limits of the value of B usually found in practice.



This curve shows the relation between volts and watts in a particular transformer when the number of pulsations per second were 84, the values of B are given together with the impressed voltages because the curve may be taken as representing very closely the relation between lost watts and values of B in transformer iron of the present time. Weight of iron = 30 lbs.

In practice, if we wish to know what loss we shall have in a transformer at a particular impressed E.M.F., and can obtain two measurements of watts with different impressed voltages in the neighbourhood of the particular one required, it will be sufficiently accurate to use the equation of a straight line in the form of

$$W = m\,E + c,$$

and from the two measurements obtained of W and E we get two equations, from which we easily find the values of the constants m and c for the particular transformer. We can then, by substituting values for m, E and c in the above equation obtain the values of W, as required.

Time, or want of it, compels me to leave points in connection with these curves for your individual study, for instance, we might consider the influence, on the system of distribution, of reducing impressed voltage during very light loads when the transformers have a high value of B, so that the slope of the curve is great; also the inadvisability of using this high value of B when it is considered that the impressed voltage will have to be raised at maximum loads.

We will now devote a few minutes to discussing the power factor of a transformer.

In 1892 this term was, I believe, first applied by Dr. Fleming to the ratio of true watts to apparent watts. Now since true watts = C E cos α and apparent watts = C E obviously cos α = power factor, which must therefore always be less than unity.

The magnitude of the power factor has a great deal of attention bestowed upon it and you will doubtless encounter men who are of the opinion that the higher the power factor the higher the efficiency; to be truthful a high power factor, where the magnetic circuit has a high reluctance, as many of the type shown in the figure must have, almost always means that B has a high value, which is an undesirable feature from many

standpoints, it is therefore well not to be carried away with the size of power factors; that a person may have an idea that high efficiency and high power factor are boon companions, is evident from the writings of those who state that: "For *good* closed circuit transformers the power factor varies from ·60 up to nearly ·90", and, again, we read what ought to have been corrected long ago: "The power factor is the ratio of current taken by the transformer at no load to the current actually required for the hysteresis."

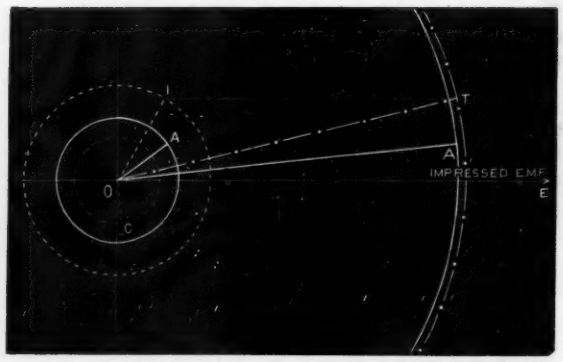
If this should be the correct definition the P.F. might be > 1.

The diagram is drawn for a system where concentric mains are used, and illustrates the case with the effect of self-induction emphasised too much rather than too little, and I have no hesitation in stating that it would be difficult to find a supply company in the United Kingdom who could measure accurately the capacity and induction currents, and prove that a transformer with a power factor greater than ·75 would be otherwise than harmful to efficient running, or that a variation in the power factor of from ·55 up to ·75 would in any practical way vary the efficiency of the system.

These remarks apply only to those companies who use concentric system of mains.

In making diagrams of this sort it is essential that the capacity current should in all cases be actually measured, *not* assumed.

* The line I T represents current supplied to transformer to meet



the load, and is in phase with the E.M.F., whose direction is that of the line O E.

The line O I represents current supplied to transformer on open circuit, power factor taken at ·5; therefore, position of line with respect to E.M.F. is known.

The line O T represents total transformer primary current at various loads and is resultant of O I and I T.

The line O C represents current supplied to mains on account of loss in the main and electrostatic capacity.

The line O A is total current as supplied from the station and is resultant of O T and O C in each case.

It often happens that if a transformer has been tested with coils and core perfectly dry, a certain lag of current behind E.M.F. is observed (call the angle of lag, θ_1, then cos θ_1 = power factor which we will call P_1), and after a few days, if the transformer has been exposed, we get a different lag and different number of absorbed true watts, although testing under precisely similar conditions to those existing when first measurements were taken.

Let θ_2 and P_2 be the lag and power factor in second case.

$$\text{Cos } \theta_2 = P_2.$$

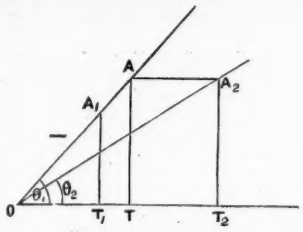
Should the additional watts be due solely to a leakage over the coils, or something of that sort, where we have a non-inductive

* This refers to tests made before transformer has done much work.

* No magnetic leakage.

circuit placed in parallel with one transformer, about whose losses we are certain from the previous tests, we have merely to deduct the watts in the first case from those observed in second case, to arrive at once at the loss due to leakage over coils, &c.

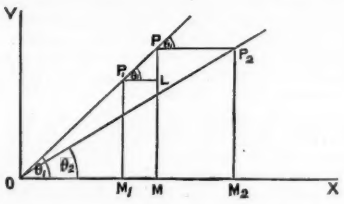
But suppose the transformers true watts to have increased to a certain extent with time of running, we may not know exactly how many of these watts may be due to damp on the coils, or whether the loss has been reduced by moisture being driven off coils: we must resort to some method for finding out and separating the loss due to increased hysteresis, and that due to damp causing leakage current, which can be considered free from a wattless constituent.



Suppose, in the figure, O T_1; O A_1; θ_1, represent true watts, apparent watts, and lag in first measurements; and O T_2; O A_2; θ_2, represent true watts, apparent watts, and lag in second measurements. We wish to find out what the true watts would have been had leakage currents not started, *i.e.*, power factor remained the same in each case.

The value of these watts will be represented by O T, the *pt* T being found by projecting from A_2, a line parallel to O T_2, and from A, where this line meets O A_1, dropping a perpendicular on O T_2. This, like other geometrical methods, depends for its accuracy upon accuracy of representation of angles and lengths, and is much more laborious than working out a formula which will hold good for all cases.

We might arrive at this formula by one or two methods, each employing the use of the most elementary trigonometry, construction as before, except for A read P, and for T read M.



Let t = watts absorbed in leakage currents; value required of t; is evidently represented by M M_2.

Let T_2 be measurement of total measured true watts in second case O $M_2 = T_2$.

Let F_1 and F_2 represent power factors in first and second cases respectively $\cos\theta_1 = F_1$ $\cos\theta_2 = F_2$.

$$t = M M_2$$
$$= P P_2$$
$$= \frac{O P_2 \sin(\theta_1 - \theta_2)}{\sin\theta_1}$$

For P P_2 sin O P P_2 = O P_2 sin P_2 O P
i.e., P P_2 sin $(180 - \theta_1)$ = O P_2 sin $(\theta_1 - \theta_2)$
and sin $(180 - \theta_1)$ = sin θ_1

$$= \frac{O M_2}{\cos\theta_2}\left(\frac{\sin\theta_1\cos\theta_2}{\sin\theta_1} - \frac{\cos\theta_1\sin\theta_2}{\cos\theta_2\sin\theta_1}\right) \times O M_2.$$

$$= T_2 - \frac{\cos\theta_1\sqrt{1-\cos^2\theta_2}}{\cos\theta_2\sqrt{1-\cos^2\theta_1}} \times T_2$$

$$i.e.\ t = T_2\left(1 - \frac{F_1}{F_2}\frac{\sqrt{1-F_2^2}}{\sqrt{1-F_1^2}}\right)$$

The formula just obtained can also be found as follows:—

$$t = T_2 - T_1 - M_1 M \qquad t = M M_2$$
$$M_1 M = P_1 L = P L \cot\theta_1$$
$$= (P M - L M)\cot\theta_1$$
$$= (P_2 M_2 - P_1 M_1)\cot\theta_1$$
$$= \{O P_2 \sin\theta_2 - O P_1 \sin\theta_1\}\cot\theta_1$$
$$= O P_2 \frac{\sin\theta_2\cos\theta_1}{\sin\theta_1} - O P_1 \cos\theta_1$$
$$= \cos\theta_1\left\{O P_2 \frac{\sqrt{1-\cos^2\theta_2}}{\sqrt{1-\cos^2\theta_1}} - O P_1\right\}$$
$$\therefore M_1 M = F_1\left\{\frac{T_2}{F_2}\frac{\sqrt{1-F_2^2}}{\sqrt{1-F_1^2}} - \frac{T_1}{F_1}\right\}.$$

$$\therefore t = T_2 - T_1 - \frac{F_1 T_2}{F_2}\frac{\sqrt{1-F_2^2}}{\sqrt{1-F_1^2}} + T_1$$

$$t = T_2\left(1 - \frac{F_1}{F_2}\frac{\sqrt{1-F_2^2}}{\sqrt{1-F_1^2}}\right)$$

To increase the efficiency of plant a trial has, I believe, been given at Portsmouth of transformers built with two primary and two secondary coils, with an arrangement worked by a small motor, to switch the two primaries in series and the two secondaries in series when the load is light, and so reduce iron losses; after the load has reached a certain value, the primaries are put in parallel and the secondaries also in parallel with each other, thus increasing the iron loss but decreasing the copper losses, which would otherwise be a large source of loss.

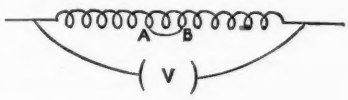
Failures.

Before quite finishing our subject, we will glance at the ways in which a transformer may temporarily or permanently end its career.

First of all we have the well known "short circuit" in the high-tension coil; this may be partial or complete, but either necessitates repair of coil.

Secondly, we have what is much less common than a short circuit in the high-tension coil—a short circuit in the low-tension coil, or perhaps the high pressure making contact with the low-tension coil; this last cause of failure as well as that due to the high-tension coil making contact with the iron core, is found almost exclusively in systems of distribution in which a conductor from the alternator is connected to and at the same potential as the earth.

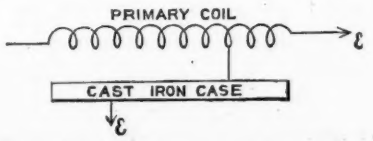
Much might be said about failures from any immediate cause, but we will confine our attention to the consideration of the effect of a short-circuit in the primary coils, and will imagine we have a partial "short," *i.e.*, a few turns, the insulation of which has given way to such an extent that its resistance is only a small fraction of an ohm.



We consider the points, A and B, on the coil to be in close proximity to each other, the insulations between them having a minute resistance. The flux produced by the current circulating round each turn and varying periodically, will produce a P.D. between A and B which will cause a current to circulate through the resistance of the fault, A B, and the turns between A and B; the intensity of, and voltage producing, this current will decide whether we have large quantities of energy lost or not, or whether the voltage of the secondary coils will be raised owing to the turns between A and B being partially cut-out of circuit.

This question of effect on secondary voltage depends on the relative position of primary and secondary coils to each other and the magnetic circuit.

A very good example of a few of the primary turns acting as a secondary to the remaining coils is the following. The diagram shows the arrangement.



A fault occurred in the primary coil near that end connected to earth, the cast-iron case of the instrument being also connected to earth, the fault making connection between winding and case as shown.

The only indication of anything strange was the warmth emitted by the hot case, the explanation is obvious from the above.

The increase in length of life of transformers, caused by earthing one pole of system of mains, may be represented diagrammatically by a very long line measured in a negative direction, but a consideration of this sort is so swamped, apparently, by others, such as increased safety, that scarcely a supply station using concentric mains could be found where the outer conductor is not earthed at the alternator.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn, London, W.C., to whom all inquiries should be addressed.*]

NEW PATENTS.—1896.

13,723. "Improvements in and in connection with incandescence electric lamps. G. Gerber and F. A. Hüller. Dated June 22nd.

13,729. "Improved process for telegraphing with Morse apparatus." L. Cerebotani and M. Bernstein. Dated June 22nd.

13,730. "Improved solenoid for electric arc lamps." M. Baumer. Dated June 22nd.

13,752. "Improvements in or relating to the mariner's compass." J. S. GIBBONS. Dated June 22nd.

13,767. "Improvements in dynamo-electric generators, motors, and transformers." E. CANTONO. Dated June 22nd. (Date applied for under Patents, &c., Act, 1883, Sec. 103, February 11th, 1896, being date of application in Italy.)

13,775. "Improvements in polyphase electric motors." H. PIEPER & FILS. Dated June 22nd.

13,814. "Improvements in electric tramways." J. ENRIGHT. Dated June 23rd.

13,824. "A standard of electromotive force or potential difference." W. HIBBERT and T. SEWELL. Dated June 23rd.

13,847. "Improvements in and relating to electro-mechanically operated gas lighters and the like." J. T. ARMSTRONG and A. ORLING. Dated June 23rd.

13,889. "Improvements in and relating to electrical distributors." L. F. OPPENHEIMER. Dated June 23rd.

13,891. "Improvements relating to incandescent electric lamps." C. ALEWIJNSE and ROOTHAAM ALEWIJNSE & Co. Dated June 23rd.

14,005. "Apparatus for automatically closing and opening by electrical agency the barriers of railway level crossings." THE RT. HON. D. M. B. H. COCHRANE (Earl of Dundonald). Dated June 24th.

14,014. "An improved electric cooking and frying or roasting apparatus." G. C. DYMOND (The Chemisch-Elektrische Fabrik "Prometheus" Gesellschaft mit beschrankter, Haftung). Dated June 24th.

14,015. "Improved electric heating device." G. C. DYMOND (The Chemisch-Elektrische Fabrik "Prometheus" Gesellschaft mit beschrankter Haftung). Dated June 24th.

14,020. "Improvements in electrically propelled velocipedes. G. P. F. CLERC and A. G. PINGAULT. Dated June 24th.

14,064. "Central battery telephone exchange system." D. SINCLAIR and W. AITKEN. Dated June 25th.

14,092. "Improvements in electric motors especially applicable to the propulsion of velocipedes and motor-cars." G. P. F. CLERC and A. G. PINGAULT. Dated June 25th.

14,157. "An improved form of washer for use connecting secondary battery lugs and other electrical conductors." J. S. HIGHFIELD. Dated June 26th.

14,187. "A portable electric drill." E. HOLMES and SIEMENS BROS. & Co., LIMITED. Dated June 26th.

14,197. "Improvements in or relating to incandescent electric lamps." C. ALEWIJNSE, and ROOTHAAM ALEWIJNSE & Co. Dated June 26th.

14,220. "Improvements in electrically heated radiators." W. B. SAYERS. Dated June 26th.

PATENTS OF 1882 EXPIRING IN JULY 1896.

We are informed by Messrs. W. P. Thompson & Co. that about 81 applications for electrical patents were filed in the month of July, 1882. Only four of the patents granted on these applications have been maintained for their full length of term, and as they are of considerable interest we give abstracts of them below.

3,204. "Generation, regulation, and utilisation of electric currents." W. R. LAKE. (Elihu Thomson, United States.) Dated July 6th, 1882.

Arc Lamps.—The tubular upper carbon holder alone is regulated by means of main and shunt circuit electro-magnets in an upper casing through the centre of which the carbon holder passes. The horizontal main circuit electro-magnet polarises a pivoted core-bar which is connected to a spring clutch by means of levers. The shunt circuit electro-magnet is vertical and polarises a fixed core-bar which opposes the action of the pivoted bar. If the feed of the carbon holder fails a safety clutch in connection with an electro-magnet of high resistance in a shunt circuit ensures the approach of the carbons. When necessary the safety clutch is raised by hand to its original position by an external rod and button. The contact for conveying the current to the carbon holder consists of a small stationary rod, to the lower end of which a fine wire brush is attached; this rod passes down the tube of the carbon holder and makes a rubbing contact with the interior of the tube. In a modified form of arc lamp a variable resistance cut-out or shunt around the separating and feeding electro-magnets is controlled by an electro-magnet in a derived circuit. In an arc lamp with a double set of carbons, carbon holders, and lifting clamps, one set is caused to burn before the other by means of a lever attached, near its centre, to the magnet system, and at each end to one of the clamps; a detent mechanism in connection with clamps, changes the fulcrum of the lever, so as to release one clamp after the consumption of the first set of carbons, and to subsequently sustain the second clamp in a fixed raised position.

Incandescent Lamps.—These lamps are of low resistance and are worked by a current of ordinary strength for an arc light. The exhausted bulb contains a light-giving compound carbon rod having a core of badly conducting carbon. The carbon blocks, between which the light-giving rod is placed, are forced together by a spring which cuts out the lamp when the rod is removed or broken. The bulb is first filled with hydrogen and then exhausted; pieces of sodium oxide and oxide of copper are placed in the bulb.

Generation.—The part of this invention which relates to the generation of electricity consists in using a dynamo machine having fixed field magnets with suitable pole pieces within which a ring armature revolves. The armature has three coils connected to single three-branched conductor. The commutator consists of three insulated removable segments and two pairs of diametrically opposite brushes, adjustable round the axis of the commutator. In high tension machines an air jet attachment ensures insulation between the commutator segments. The magnet poles are surrounded by a copper band forming a closed circuit, to prevent sudden fluctuations of magnetic power. A triple condenser is employed in combination with the segments and armature coils.

Regulation.—The part of this invention which relates to regulating the electric current consists of an electro-magnetic attachment which automatically adjusts the position of the brushes round the commutator, so as to regulate the strength of the current, according to the resistance. In one apparatus all the brushes are moved "forward," that is in the direction of the rotation of the armature. In a second apparatus the same result is effected by moving one pair of opposite brushes forward and the other pair backward, the rate of movement of the latter pair being three or four times as great as that of the first pair.

3,419. "Dynamo machines." S. Z. DE FERRANTI and A. THOMPSON. Dated July 18th, 1882. Instead of producing alternating currents by means of bobbins set round the circumference of a wheel which is caused to rotate rapidly, so that the bobbins are carried between alternate poles of field magnets, the inventor substitutes for the separate windings of the bobbins, one single conductor passing in an undulating form round the wheel. There are no iron armature pole pieces, but the zigzag conductor is so formed that its radial parts are at the same distance apart as the field magnet poles on either side of it. The conductor is bolted to the wheel so as to transmit thereto the centrifugal strain of rotation which tends to separate it from the wheel. The insulated conductor may be first wound in the form of a hoop, and then bent, by suitable tools, into the zigzag form. The field magnets are wound upon a double zigzag method.

3,281. "Arrangement and application of electrical conductors." F. JACOB. Dated July 11th, 1882. This invention is an extension of that set forth in Specification No. 231, A.D. 1882, and applies to conductors generally, whether they are used for telephones, telegraphs, electric lights, electric motors, or other apparatus. Several sets of electrical instruments, or apparatus, are connected by employing the double conductors of one set as a single conductor for another set, and multiples of such double lines as single lines. In cases where the earth may be used instead of the return wire, a certain instrument may have its double wire, and these two wires, with earth for return, may work another instrument, or an extended arrangement may be used on this plan, two instruments having their respective pairs of wires, and the earth circuits in combination with the two pairs of wires providing as many circuits as there are wires. The instruments of these circuits can be operated simultaneously without interfering with one another. Any known kind of conductors may be employed to carry out this invention and along with suitable resistances, condensers, or other known arrangements for determining the various circuits.

3,576. "Distributing and measuring electricity." J. HOPKINSON. Dated July 27th, 1882. When the electricity is to be used at a distance from the dynamo, this invention enables the difference of potential between the two conductors at the place of use to be indicated and maintained at a constant value. A differentially wound galvanometer is employed for this purpose, one coil having a high resistance and the other a low resistance; the first coil is a shunt to the whole circuit, the second coil is in the main circuit or embraces a proportional part thereof. The differential instrument may be made to act as a relay to ring bells or to indicating or regulating apparatus. This instrument may be applied in the case of distributing mains with dynamos and feeders therefrom at various parts of the system. To employ a lower potential, in the houses in which the electricity is used, than that in the mains, a system of three conductors in combination with two dynamos coupled in series is employed. There may be more than three conductors and more than two dynamos. The above indicating or regulating apparatus is applied to the three-wire system of conductors by winding a third coil to convey the current going or returning by the intermediate conductor. To remove a dynamo from the external circuit or to change a circuit from one dynamo to another, an electro-magnetic switch is used. When the speed of a dynamo diminishes, the automatic switch piece connected with the armature drops. The transfer of a conductor from one dynamo to another may be made without disturbing the supply.

The current meter described in Specification No. 49, of A.D. 1882, according to the present improvement, has a rubbing contact at the part where the circuit of the motor of the meter is broken in order to keep the two surfaces clean.

An application to amend was filed on March 18th, 1891. Amendment made July 15th, 1891.

A petition for the prolongation of this patent was made by J. Hopkinson and The Westinghouse Electric Company, Limited, on January 10th, 1896. This petition will shortly be heard before the Privy Council.

ABSTRACT OF PUBLISHED SPECIFICATION.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., *price, post free,* 8½*d.* (*in stamps.*)]

1895.

8,966. "Improvements in electromotors applicable for use as electric meters." H. A. ROWLAND. Dated May 6th, 1895. One improvement consists in supporting the coils of the meter by the same non-magnetic conductor which produces the damping effect by its revolution in the magnetic field. This combination of a motor and conductor is not only eminently adapted for measuring an electric current, but is suitable, on account of its uniformity of speed, for driving clocks for astronomical purposes, chronographs, &c. 8 claims.